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Evaluation of the Luxembourg Institute of Science and Technology (LIST) – Synthesis Report on the Institute Level

Report by the external peer review committee

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Executive summary

This report presents the results of the peer review at institute level of the Luxembourg Institute of Science and Technology (LIST), assessing the performance of LIST in the period 2014-2017, with a focus on the post-merger years 2015-2017. The peer review is part of an evaluation of the three Luxembourg research centres (CRP) under the responsibility of MESR. The evaluation has been assigned to Technopolis Group (www.technopolis-group.com).

LIST started in January 2015 as a merger of the research centres Lippmann and Tudor. Although the starting years for LIST were difficult and LIST has not yet developed into a smoothly running RTO yet, the peer review committee is of the opinion that the decision to form LIST was a right decision from the Luxembourg state perspective and the added value starts to be realised.

According to the law, *"LIST's specific mission is to carry out innovation and scientific research activities oriented by the needs and interests of public or private socio-economic actors…"*. The short-term CEO of LIST interpreted this mission as to perform R&D activities with a focus on TRL 3-7. The better equilibration of research for knowledge generation versus valorisation of research and impact and the introduction of TRL for specific issues had a positive impact in LIST, as it increased attention to stages of maturity from research to implementation and stimulated entrepreneurial esprit. The TRL 3-7 focus at LIST should however not be interpreted as a limitation to TRL 3-7 activities alone, because such a limitation would be inappropriate for the mission of a Science and Research Institute, neglect scientific excellence and set insufficient incentives to demand-side driven innovation projects. For development and service projects in close collaboration with customers the assetisation cycle "Asset-ise, deploy, and learn" seems better suited.

The evaluations of the three departments show that there is a medium to high quality of research activities already in many areas (ranging from 'a national player' to 'internationally leading'), and a high potential for further development and international deployment in most domains. At LIST there is still room for a more focused thematic scope on the one hand and for more spatial deployment on the other, notably on the international level.

LIST had received slightly more than 60% block grant, providing LIST with a solid financial foundation and the opportunity to engage in new research domains, to finance change and to be free of the every-days stress of running after third party money. A future-oriented, dynamic development of LIST is somehow hampered by contradictory incentives set by this very generous basic funding, especially due to a ceiling in contract research of 20%, to avoid the positioning of LIST as an undertaking, in compliance with European state aid rules.

The spending of the block grant is not fully transparent and only for a small part used for internally defined and performed research programmes and projects (which is what base funding is used for in many other RTOs with significant public funding). This undermines a growth-oriented thinking and acting both at top level as well as department level. Budgeting (and reporting) seems to be done at a fairly high level of aggregation. The lack of information on department and unit level makes effective management of the organisation difficult.

Additional income from competitive sources and contract research represents 37% of total financing over the years 2015-2017, and lacks behind objectives defined in the performance contract (40%): Especially ITIS is far from reaching the target (in 2016-2017, ITIS realised only 23% external income). ERIN is close to the 40% target (40 % in 2016, 38% in 2017), while MRT surpassed the target with 45% external income. The non-achievement of the third-party income target had no financial consequences for LIST in terms of basic funding, although this may on the short term be beneficial for LIST, it does not provide LIST with the incentive to make better use of the block grant in the future.

Cooperation and networking between UL and CRP are of great importance for Luxembourg as a small country and for LIST. Networks in Luxembourg are well developed, although the relation between ITIS and UL-SnT requires attention. Stakeholders from industry express a high degree of satisfaction with the services of LIST. There is still limited internal cooperation in LIST. International cooperation leaves room for improvement.

Overall, LIST achieved most of its KPIs (set aside third-party income), however the questions arises whether the present KPIs are the most suitable KPIs for LIST and whether the targets are at the right level of ambition. KPIs for valorisation/KTT need to be developed.

In organisational terms, this led to an overload with support units and support staff (in total 127 staff representing more than 20% of overall staff), which consumes a considerable share of the block grant. On the level of the research departments, at several points it is perceived as a bureaucratic burden with limited added value. Crucial (Senior) management functions have remained vacant for quite some time. In general management processes there is a strong tendency to central decision making and appeasement. Delegation tends to more often upwards than downwards, not making effective use of the creativity and power in the organisation to deal with problems and opportunities. Merger consequences have led to a severe staff dissatisfaction within estimated 15-30% of staff, that has not been dissolved and still causes problems, which have started to be addressed more recently.

Recruitment at LIST does not meet more serious difficulties than are normal to the labour market. The institute shows however an unbalanced gender distribution and in particular a low number of female leaders, except at the Board of Directors. There appears to be no comprehensive policy concerning gender. A general framework for careers and promotions within LIST was missing, and start to be implemented based on a first LIST collective agreement signed in 2017. The PhD policy put in place works well.

The research facilities at LIST are good and are very well managed. Overall, working conditions of scientists and technical staff at LIST seem to be are attractive and competitive, appropriate compared to international standards.

In terms of governance, the multiannual performance contract is a suitable instrument for MESR to steer LIST. It provides LIST with longer term financial stability necessary to develop and implement a distinctive strategy, and, with the right KPIs, it also provides the opportunity for MESR to stimulate LIST to contribute to MESR policy goals.

There is an imbalance in the supervision of LIST within the MESR-BoD-CEO triangle, resulting in a lack of supervisory responsibilities. The key bottleneck is not in the formal way it is organised, but in implementation.

Main **recommendations** for LIST address a more explicit strategy formulation process, more transparent and strategic use of block grant, the broad achievement of additional external funding, stonger focus, increased internal cooperation and international outreach. This calls for a change of culture across LIST with attention for values, attitudes and routines.

1. One and only one mission statement should be elaborated and communicated.
2. LIST should increase the focus on research and innovation across all departments, and prioritise and posterioritise, in order to gain in critical mass and increase its (international) impact in science and on the market and to make room for emerging research themes.
3. Develop a structured process for strategic decision-making, at institute level and (in a coordinated way) at department level in order to realise this increased focus. Set up external scientific (and maybe societal) advisory boards in order to support this process and support in implementing the strategy and monitoring the impacts.
4. Implement the strategy by making strategic use of the block grant.
5. The block grant should be attributed in a transparent way.

6. Taking into consideration European State Aid rule, comparable strategies to other European RTOs should be developed to adopt a business model that provides positive incentives to offer research service to customers on a real and full cost basis, next to collaborative projects and competitive funding.
7. Integrate and rebalance the support functions.
8. Improve HR at the level of a corporate culture with shared LIST goals, more self-confidence and more inter-department cooperation. Fill the management vacancies, develop a career development plan system and develop an explicit gender policy (including a programme to attract female researchers and female experts for leading positions within LIST).
9. Strengthen internal cooperation with incentives and appropriate KPIs. Platforms with a transversal function may provide a useful organisational model and may even include selected teams of UL and possibly LIH and LISER.
10. KPIs need to be defined so that excellence of research as well as transfer and valorisation of knowledge and their national, respectively international relevance have appropriate weight. Other KPI should relate to internal cooperation, thematic focussing and career plans, including gender related policies.
11. Continue the activities in the field of valorisation, with appropriate attention for patents as a means to generate knowledge transfer and business.
12. Try to bring service activities for the central Luxembourg government in the environmental field under one umbrella, fully financed by the Ministry of Environment, while using the block grant from the Ministry of Research for knowledge-development oriented activities.
13. Work actively on a change of culture across LIST, from the top (BoD, CEO and management team including heads of departments) to the bottom of the organisation: work on values (e.g. rewarding over-achievement and penalising under-achievement), attitudes (e.g. entrepreneurship and leadership over administration) and routines (e.g. the agenda of the regular meetings of the BoD).
14. The Luxembourg Government should reward (provide incentives for) complementary cooperation between the national players of higher education, research and innovation for the better international visibility of Luxembourg.
15. Adapt KPIs of LIST to better reflect the RTO role both as a research service provider, and as research partner for companies and other organisations. Consider rewards when (ambitious) KPI-targets are met and penalties when KPI targets are not met, including third party financing.
16. Empower the BoD and the CEO of LIST by more systematic interaction on the use of the block grant with the BoD of LIST, both forward looking in terms of strategies and plans, as well as backward looking in terms of reporting about implementation. Consider, with the BoD, the establishment of an external advisory council to support the CEO.

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1 Introduction and background

1.1 LIST

1.1.1 History

This report presents the results of the peer review of the Luxembourg Institute of Science and Technology (LIST), assessing the performance of LIST in the period 2014-2017, with a focus on the post-merger years 2015-2017. This period was a turbulent period for LIST. In 2011 an external evaluation of the materials research in Luxembourg recommended to merge the materials R&D units from CRP Gabriel Lippmann and CRP Henri Tudor (CRP=Public Research Centre). Influenced by this advice, and as part of the transformation of all CRP into new Luxembourg Institutes, the Ministry for Higher Education and Research (MESR) decided in 2014 to merge the entire CRP Lippmann and Tudor into one institute, the new Luxembourg Institute of Science and Technology (LIST) that started on January 1st, 2015. Because of differences in focus (e.g. Lippmann more oriented towards use inspired fundamental research, Tudor more towards application oriented research and technology development and services; thematic differences), arising leadership issues (the first LIST CEO was forced to stepdown by the LIST Board of Directors after about a year and a half in office) and issues in HR and governance, the first few years of LIST (that are covered by this evaluation) were difficult. As this evaluation will show, these post-merger issues are still noticeable within LIST and partly hampered the development of LIST into a mature Research and Technology Organisation (RTO), despite large efforts by the CEO ad interim and his team in the period 2016-2018.

The conclusion and recommendations of this evaluation need to be seen against this history. Even though LIST has not yet developed into a smoothly running RTO, the peer review committee is of the opinion that the decision to form LIST, with a focus on Science and Technology, was a right decision from the Luxembourg State perspective and the added value has started to be realised.

1.2 This peer review

The peer review is part of an evaluation of the three public research Centres in Luxembourg (Centre de Recherche Public – CRP, the former CRP's LIH, LISER and LIST) under the responsibility of MESR. The evaluation covers the period 2014-2017 and considers performance and impact in science, technology and innovation, collaboration with UL and PhD formation, relevance for society including client and partner interaction and the governance and organisation as requirement to sustain the ability and suitability for promoting both scientific performance and interaction with clients. The evaluation has been assigned to Technopolis Group (www.technopolis-group.com).

The peer review of LIST consists of separate peer reviews of each of the three departments of LIST (ERIN, ITIS and MRT) with a focus on scientific quality and innovation impact, and this peer review at institute level with a focus on management, organisation and governance. These departments have been created in 2015, in the newly established institute. The peer reviews at department level were all performed by teams of independent, external experts with a scientific or management background in topical area of the department, supported by two evaluation experts of Technopolis Group. The chairs of the teams of ITIS and MRT both had former experience in Luxembourg, independent from LIST. The peer review at institute level was conducted by the chair persons of the three department-level-peer reviews, again supported by the Technopolis team.

The results of these four peer reviews form the evaluation of LIST as an institute, and feed into the evaluation of the role of three CRP in the Luxembourg science and innovation system at national level. The results are intended for MESR to (re)define their relation to the institutes; for the institutes to help them to benchmark and improve their performance further and for other (mainly public)-stakeholders to use as they find suitable.

The peer review set-up has been designed by Technopolis Group, based on the terms of reference from MESR. It aligns with good practices used in many evaluations.

1.3 Composition of the Committee, independence, data provided, and procedures followed

1.3.1 Composition of the Committee

The peer review of LIST at institute level was performed by an independent external assessment committee, the chairs of the three LIST departmental peer reviews:

- **Louis Schlapbach** (Chair, also chair of MRT evaluation), Prof.em. ETH and Université de Fribourg, Experimental Physicist, Director Empa 2001-2009, Expert for FNR. Member of evaluation and interview teams for MESR and University of Luxembourg (UL) over many years.
- **Colette Rolland** (chair of ITIS evaluation) is Prof. em. of Computer Science at the University Paris1 Panthéon-Sorbonne. Member of evaluation teams in Luxembourg before.
- **Marc Benoît** (chair of ERIN evaluation), senior scientist, environmental agronomy, INRA (France).

Short CV's of all assessment committee members are attached in Appendix A.

Fritz Ohler, Geert van der Veen and **Katharina Warta** (Technopolis Group) acted as support for the peer review committee, Fritz Ohler with specific attention for governance and organisation.

1.3.2 Independence

Any existing personal or professional relationships between committee members and programmes under review were reported and discussed in the committee meeting to safeguard an independent assessment of the quality of LIST in an unbiased and independent way. The Committee concluded that there were no close relations or dependencies and that there was no risk in terms of bias or undue influence.

1.3.3 Data provided to the Committee

In preparation of the review the peers received the following information:

- The self-assessment report of LIST at institute level.
- The self-assessment reports of LIST at department level.
- A background report for the peer review of LIST prepared by Technopolis Group, including amongst others an analysis of the participation of LIST in FNR and EC research projects, completed by an erratum note added by LIST for each of the departments, and a bibliometric analysis of the publications of LIST (by ECOOM). LIST provided corrections to
- An internal background note on the management, organisation and governance of LIST, prepared by Technopolis Group.

During the on-site visits and discussions, the peers received additional information on performance, including PowerPoint-presentations. During de editing of the evaluation report, draft reports of the peer reviews of the departments have been available.

The assessment in combination with the discussions of the peer review committee with the management, the Board and other stakeholders allowed an objective evaluation of LIST.

1.3.4 Procedures followed by the Committee

The final assessments are based on the documentation mentioned above and the site visit to LIST in Luxembourg on 8-9 October 2018, including all material provided by the Institute-before, during and after the site-visit (programme of the site-visit in Appendix B).

At the beginning of the site visit, the Committee agreed upon procedural matters and aspects of the assessment.

At the end of the site visit and interviews the Committee elaborated and discussed the conclusions and recommendations. Draft conclusions were presented to the participants in the discussions including the management of LIST and representatives of MESR.

Integrating contributions of peers, Technopolis assisted the panel in elaborating a draft report which circulated several times by email for maturation.

An advanced version was presented to LIST mid-December 2018. The reaction of LIST was discussed by email by the Committee and led to adjustments of some factual points and clarifications. The final report was then submitted to MESR.

2 Rationale and needs, mission statement

Around 2010, Luxembourg started initiatives to develop the University and the Public Research Centers, to develop their quality, international visibility and their economic and societal impact. The Law of 03.12.2014 on the organization of the Public Research Centres was a starting point for definition of the mission of LIST in 2015. In addition to the general missions of all Luxembourgish research centres (article 4) to develop and undertake oriented fundamental and applied research activities as a necessary support for research, development and innovation activities and to transfer knowledge and technology to the public and private sectors, according to the law (article 30) it was stated:

> *"LIST's specific mission is to carry out innovation and scientific research activities oriented by the needs and interests of public or private socio-economic actors. LIST aims to combine socio-economic purpose and scientific excellence in its fields of competence by favouring a multidisciplinary and interdisciplinary approach and open innovation. LIST aims to translate the results of these research activities into innovations that are useful and sustainable for the economy and society. The scientific knowledge created benefits society in general and the international scientific community in particular."*

Since then, under the leadership of Gabriel Crean (May 2015 - Oct 2016), the mission has been reformulated internally and in accordance with MESR and the Board of Directors (BoD), in order to position it as a fully operational Research and Technology Organisation (RTO) anchored in Luxembourg. The positioning refers firstly to the definition of RTOs provided by EARTO and is specified secondly internally by defining the range of Technology Readiness Levels (TRL) 3-7 as relevant for LIST. This positioning is presented along with a bridging role of LIST, between actors from the academic world and business and society.

The formulation of the mission as presented by LIST to the outside world is not always identical. According to its Self-Assessment Report, LIST contributes to society by becoming a fully operational research and technology organization (RTO) anchored in Luxembourg, with a strong influence in Europe, positively impacting the country's socio-economic development. LIST undertakes research, development and innovation activities in order to promote the generation and transfer of knowledge and technology and secure scientific and technological cooperation at national and international level.

The mission of LIST on the LIST website[1] states: "We contribute to Luxembourg's reputation through our participation in several targeted research areas among the best RTOs in Europe, and by doing so, accelerate the country's socio-economic development. Put in a nutshell, LIST contributes strongly to the building of tomorrow's Luxembourg".

LIST has the ambition:

- To be the catalyst of national ambition in innovation.
- To accelerate the marketing of technological innovations.
- To be a positive driving force for industry and innovation in Luxembourg.
- To promote Luxembourg as a testbed of European innovation.
- To provide advice and expertise for national policies.

In all cases, reference to societal challenges apart from economic development are missing.

Complementarity and collaborations with other Luxembourgish research, innovation and education institutions – a must in a small country – are not described in mission/vision statements.

Furthermore, the peer review teams observed a certain struggle in each department to position themselves between scientific excellence and service to society: A closer look showed that TRL3-7 is not

[1] Access on 2.11.2018

'one size fits all'. TRL are appropriate for technology development projects, low TRL are not well suited to describe use inspired research. The use of TRL for the formulation of the mission of science and technology institutes is quite unusual internationally. Neither benchmark institutions like VTT ("Impact through scientific and technological excellence") or Empa ("A place where Innovation starts") do refer to TRL in mission/vision statements, nor does EuMaT (the European Technology Platform for Advanced Engineering Materials and Technology, Strategic Research 2017), and they are not foreseen in the law. With respect to LIST, on the one hand, in some domains, use inspired fundamental research is a must to generate new knowledge, to be respected and to attract talent, important issues in a centre with 60% core funding. On the other hand, there is no reason not to engage the implementation of research results in a users' context (TLR 8 or 9)[2] in certain domains, as long as these competences are related to in-house research and development[3] and as long as the related services are sold at full cost. TRL's had been introduced by NASA for (space) technology developments and are not necessarily appropriate for knowledge generation and asking good questions (requirements, problems, challenges) in other domains.

Adding the TRL-approach had a positive impact in LIST, as it increased attention to stages of maturity, from research to implementation, and stimulated entrepreneurial spirit. However, the TRL 3-7 focus at LIST should not be interpreted as a limitation to TRL 3-7 activities alone, because such a limitation would be inappropriate for the mission of a Science and Research Institute, as it would neglect scientific excellence and would set insufficient incentives to demand-side driven innovation projects. LIST was formed as Institute for Science and Technology and wants to be an RTO, a Research and Technology Organisation. RTOs are characterized by creative and systematic work to increase the stock of knowledge. The generation of knowledge is an integrative part of research and of the culture of science. Research and excellence should therefore regain importance in the implementation of LIST's mission. This is in line with the agreed high rate of around 60% block grant and 40 % competitive and collaborative funding including services income.

Key Performance Indicators (KPI) need to be defined so that excellence of research as well as transfer and valorisation of knowledge and their national, respectively international relevance have appropriate weight.

The conceptual model of the bridge gave a clear sense of direction in the early years of LIST. Presentation of research groups during the peer reviews showed that it helped framing various projects in a broader context and along a timeline with improving partnerships and assets. In the medium to long term, however, especially combined with the TRL-taxonomy going from the left to the right, it is too linear, not considering sufficiently demand-side stimulation for research questions (traffic in both directions), and too static, as it does not take changes in surroundings into account. For development and service projects in close collaboration with customers the assetisation cycle "Asset-ise, deploy, and learn" (explicitly used in the ITIS department) seems better suited than the bridging model.

The evaluations of the three departments show that there is a medium or high quality of research activities already in many areas, and a high potential for further development and international deployment in most of the domains, if not in all them (see chapter 3.1). However, a future-oriented, dynamic development is somehow hampered by contradictory incentives set by the generous block funding. In particular, European state aid rules introduce a ceiling, as they limit the access to high block funding for "undertakings", meaning organisations with more than 20% of their activities in competitive price markets (see chapter 3.3.1 for more details on reduction in contract research). In this context, instead of focusing on a clear distinction between research as a service and standard services that can also be obtained on the market, a broad category of collaborative projects and PPPs has been opened and put in the focus of LIST's activities. Indeed, cooperation with partner institutes and partner companies is welcome, however, a closer look at various of these projects indicates that risk-sharing

[2] TRL 8 – system complete and qualified, TRL 9 – actual system proven in operational environment (competitive manufacturing in the case of key enabling technologies; or in space), ibid.

[3] The outsourcing of certain service activities notably in the IT domain following the merger is coherent with this approach, as these services were not based on in-house development.

between LIST and partners/clients varies, with some tendency of possible cost carriage by LIST in projects that might, in economically tougher contexts, be negotiated as research service contracts fully paid by the clients/partners.

Incentive structures of this kind tend to lead to distorted cost appreciations, increasing instead of decreasing the dependency on block grants even in highly demand pulled domains. As the mission of LIST is in particular to "*carry out innovation and scientific research activities oriented by the needs and interests of public or private socio-economic actors*", a clear definition of the strategic use of block grants, and a smoother – and profitable – responsiveness to users' demand should help clarifying strategy and focus of LIST.

Both the mission and the strategy have been formulated so far in rather generic terms: in various respects, 3,5 years after the merger and taken into account the number of vacancies and interim engagements in leadership positions, it can be clearly stated that LIST has developed an important set of activities, in research, cooperation and valorisation, and higher education in line with its mission and to the benefit of Luxembourg's economy and society. Themes of LIST research resonate discussions about research in Luxembourg at the political level. However, the prioritisation and strategic decision processes both at the Luxembourg level and at LIST level are not sufficiently developed. There is still room for a more focused thematic scope on the one hand and for more spatial deployment on the other, notably on the international level.

3 Outputs and impacts, quality, competitivity

3.1 Research

3.1.1 Thematic focus, critical mass in the research activities

LIST encompasses three departments, in the domains of materials (MRT), environment (ERIN) and IT (ITIS). The thematic fields have initially been defined in the law (Art 30/2), and revised later, in coherence with the overall research landscape (i.e. transfer of health-related competences to LIH). Today, all three domains are of global importance. Not only the different domains, but also the quite different impact and performance of the three departments, nationally and internationally, render governance and evaluation more demanding.

Many thematic research fields were developed from activities of the Tudor and Lippmann research centres, based on the strengths of Luxembourg industry (traditionally the steel industry) and on the needs of society, including the need to diversify the economic structure. The strong selection criteria of FNR contributed to the shaping of the portfolio e.g. by PEARL, CORE, and PPP programmes.

On the national level at present, there are a multitude of industrial activities in Luxembourg,[4] in particular in the field of chemistry, plastic, rubber and synthetic materials, mechanical engineering and processing of ferrous and non-ferrous metals, the automotive industry, precision instrument engineering, electronic delivery services, glass and wood industry. Furthermore, Luxembourg developed into an international financial centre, with 150 highly competitive banking institutions, a high performing investment funds sector, a dynamic insurance sector and a multitude of professionals and specialised companies offering a comprehensive range of diverse and innovative financial services. The desire to further diversification of services led, from the 1980ties onwards, to the creation and development of activities in the field of insurance and reinsurance, transport, trade, tourism, telecommunications, e-commerce, broadcasting and business services.

The focus of research activities in LIST seems to align at least to a certain extent with the economic focus of the country, although it does not cover the full spectrum of the whole industry (which is impossible for a fairly small institute anyway). The assessment of the research & development portfolio at department level shows quite some variety – all department peer review teams indicate there should be more focus in the activities of LIST. The 8 thematic topics as presented in the 2018-2021 strategy[5] provide a useful focus that is however not yet sufficiently narrow for LIST to be able to excel at international level:

- At MRT, the review team recommends that more focus is needed to further strengthen the partially already high quality, international visibility and national appreciation of the department. With structured processes, posteriorities should be identified and phased out, and spin-off actions initiated to allow for strengthening priority fields and new challenges.
- At the ITIS review, it is recommended to keep the focus and the organisational structure, while making the strategy more explicit and more coherently presented and implemented. Complementarity rather than competitivity to SnT at UL needs to be developed to guarantee continuous support.
- At ERIN, the review team concluded that it is possible to strengthen coherence of the research agenda. The committee suggests developing an overall departmental strategy to strengthen coherence and critical mass in certain areas to reach an internationally leading position in one or two areas while maintaining the broad service role for Luxembourg.

At institute level, despite generous funding by the government, LIST is only using a fraction of its support to fund internal strategic research, as will be further discussed in chapter 4.1. The criteria for prioritising in research and the process for selection of research topics are unclear. The interests of individual researchers (of whom about two thirds have permanent contracts) seem leading in the

[4] Based on http://luxembourg.public.lu/en/index.html

[5] Presented in the SAR, page 9.

research strategy. This does not necessarily lead to low research quality at a first stance, but it reduces the potential for synergies inside Luxembourgish research, innovation and education system and makes it difficult to achieve the critical mass to reach the international level of excellence that LIST aspires to.

Visionary leadership with clear ambitions, related to mission, megatrends and opportunities should be strengthened. Explicit thematic strategies, formal strategy processes and external strategic advisory boards at the various levels in LIST are recommended. In particular, a Research an Innovation Council with external and internal members, with rather frequent meetings to evaluate internal proposals, should be established.

3.1.2 Productivity, quality and competitivity of LIST's R&D and innovation work

In order to evaluate the performance of institutions active like LIST in Science-Technology-Innovation-Education, the following main assets should be considered, respecting the size of the institution:

- funding and competitive funding, other income e.g. from industry contracts, services, licences
- publications, their quality and impact, including international and national joint publications, invited talks
- patents, licences, spin-offs
- collaborations with partners from academia and economy, PPP, realized impact
- benchmarks

The focus of research at LIST was definitely modified by the renewed mission statements: this led to more attention for socio-economic impact and somewhat reduced weight for scientific performance. KPIs in the performance contract are however primarily scientific and were almost all met, apart from the number of finished PhD theses and the number of publications in ISI/Scopus for 2017. **Error! Reference source not found.** gives an overview of KPI for the years 2015-2017, green cells implicate that targets are met, red means they are not met. The trend in realisation of the KPIs is however negative over the years, while the targets for the KPIs showed an increase.

Table 1 Overview of LIST scientific KPIs and achievements (2015-2017)

	2015		2016		2017	
	target	achieved	target	achieved	target	achieved
# peer reviewed publications (/researcher/y)*	0.90	1.13	0.95	1.03	1.0	1.04
# publications in ISI/Scopus (/researcher/y)*	0.77	0.86	0.80	0.86	0.90	0.76
# publications with IF>2 (/y)	125	194	130	207	140	152
number of scientific visitors (p*m)	45 (73.3)					
number of PhD-theses	90 (59)					

Source: LIST SAR: *a researcher is a scientist performing research, excluding technical and administrative support and excluding trainees not preparing for a PhD thesis

Bibliometric analysis[6] shows that the scientific impact of LIST compares to international standards. Not taking the publications of Tudor and Lippmann into account, those publications of LIST for which a citation analysis could be executed (basically the 2015 publications, because a three-year time window

[6] Performed by ECOOM for this evaluation: Bibliometric screening of Luxembourg Institute of Science and Technology, ECOOM, Leuven, August 2018.

of citation must be available), have been published in journals that have a citation impact slightly above world average, and are cited more or less the same as other articles in those journals (so also slightly above world average). There are fairly large differences between the three departments of LIST in terms of citation scores.

- MRT publishes in high-impact journals and receives less citations than the average of these journals.
- ERIN publishes on an average in high-impact journals and receive more citations than expected for these journals.
- ITIS publishes less and in the lower impact journals, publication intensity has declined during the evaluation period and is below the KPI in the performance contract.[7]

The evaluation also refers to the number and share of papers according to the four-class scheme of the self-adjusting method of Characteristic Scores and Scales (CSS), indicating above average performance: the share of poorly cited papers of LIST is distinctly below the reference standard, while the share of papers in all other three classes lies above the corresponding reference value. Usually about 9% of the papers in the total reference population are considered highly cited, while at LIST (this is including Lippmann and Tudor) the corresponding share reaches 12.9%. This reinforces the findings in the context of the relative citation indicators.

During the peer reviews, more recent research was taken also into account in a more qualitative way, according to a set of dimensions, as for instance international visibility or relevance:

- The Committee at MRT concludes that MRT-LIST developed very well, despite the challenging years of the evaluation period with moving targets with respect to the balance between research and innovation, especially over the last two years. In terms of research competitivity, MRT reached international competitive level in topics of materials science and engineering, and creates impact in national cooperation with industry. Firm developments have been shown over the past years in e.g. scientific output at higher impact levels, high number of patent applications and PhD training. The output quality and quantity differ however significantly between units.
- The Committee at ERIN concludes that the overall scientific performance of ERIN is good enough to be internationally visible and active to a limited degree. ERIN's research productivity is adequate, with about one publication per FTE position on average across the department. International research partnerships are diverse and well developed across the different units/groups. Part of the ERIN research has relevance for environmental policy making in Luxembourg as well. The overall mission and goals of LIST-ERIN are clearly stated and executed. The department lives up to its mission and goals in practice.
- The Committee at ITIS considers that the merger of Lippmann and Tudor has had quite some impact on the department. Despite the related significant tension on staff, the department achieved a number of successes in terms of output and impact. The research and development work in the ITIS department mainly focusses on national services and business. Relative weaknesses appear in FNR funded research and as a consequence in overall income from competitive funding. Today, in terms of (scientific) performance, ITIS is mainly in the position of a national player, with some specific research areas where its' results obtain very good international impact. They have the potential to reach this level across the board, and the committee sees signs of improvements and growth.

Looking across departments, it can be concluded that the merger of Lippmann and Tudor has had a short-term negative impact on scientific performance in the past years. Some departments suffered more than others, and some departments are further on their road to recovery than others as well. However, the potential is there: All departments have a lot of room for improvement in terms of research quality and international positioning. As been said, a more explicit and focused research strategy with attention for renewal of knowledge base (respect from possible (academic) partners, long term

[7] The peer reviewers noted that refereed conference papers correspond to a massively used way to disseminate knowledge in the domain of IT IS but are not included in these indicators.

competitive position), more EC funded projects and industrial and societal application of the present knowledge is necessary for LIST to become among the leading RTOs in Europe.

When comparing block grant versus competitive third-party contributions, the three departments perform quite differently: whereas 2017 all three departments had very little EU funding (< 1 M€ each), MRT created around 6 M€ FNR funding, ERIN around 4 M€, and ITIS 1.2 M€ only. For collaborative & contract revenues again, ITIS produced < 1 M€ as compared to 3.7 and 3.8 M€ for ERIN and MRT, respectively.

3.2 Cooperation and networks

The mission and ambitions of LIST include being a positive driving force for industry and innovation in Luxembourg as well as to provide advice and expertise for national policies. This means that LIST must provide knowledge of at least good international quality, and in some areas (where the Luxembourg industry and economy is operating worldwide, e.g. cyber security) even very good knowledge. In order to achieve this, the need to focus has already been stressed.

Luxembourg is a small country. This means, even when public R&D is very well funded, the absolute size of public research institutes will be rather small (with around 600 staff, LIST is not a very large institute) and cannot focus on all themes relevant for Luxembourg. In this context, both focussing and cooperation & networking are of great importance, both on the research side (to get access to additional knowledge), and on the innovation side (to be able to translate the research into innovations and transfer these innovations to other actors in society). Internal cooperation can be a promotor for interdisciplinary research, which often has a positive impact on innovation.

In terms of research cooperation, LIST improved the collaboration with the University of Luxembourg (UL) over the evaluation period and has the intention to continue to do so. A growing percentage of the PhD students employed by LIST is enrolled at UL and participates in joint Doctoral School programs. Qualified researchers from LIST fulfil teaching roles at UL. As UL is at present a young, still growing university, it is not covering all research topics that are relevant for LIST (e.g. no chemistry or environmental sciences unit). In missing disciplines, LIST teams collaborate with universities outside Luxembourg. Long-term, stable, cooperation is established with other universities, primarily in France, Belgium and Germany, with very positive impacts.

There is still room for improvement of collaboration with UL, a stronger collaboration with UL should lead to positive rethinking of portfolios with a check for duplicates and consequently possibly to a few shifts of activities between UL and LIST. The already quite developed collaboration MRT-PHYMS profits from excellent recruitment and growing reciprocal respecting. The collaboration ERIN-UL does not have weight in the ERIN report. There is a need for clarification concerning the activities of the interdisciplinary SnT center of the University and those of the ITIS department, where overlaps are perceived both by the researchers of the department and by external stakeholders, despite different orientations and missions. The focus should be clearly laid on complementarities rather than competition.

Competitive participation in EU programs is an access opener for international networking and cooperation in academic and industrial worlds. MRT is an appreciated partner in international networking of scientific research institutions, both, academic and governmental labs; joint publications are a good indicator. ERIN has built interesting international cooperations, especially in the water and the sustainability research field and cooperates with ESA. International partnership seems to be of lesser importance for ITIS, but it has some areas where the department is good enough to be visible and active at the international level; typical publications are reviewed conference papers (valid internationally for IT field). There is room for improvement in all departments. An ERC grant should be an ambitious goal.

LIST, especially MRT, is a strong user of the new CORE-PPP call introduced by FNR to encourage collaborative projects between private companies and UL or a CRP. Discussion rounds with stakeholders from industry revealed high degree of satisfaction by both, SMEs and large companies about the cooperation with LIST. The number of partners the peer review teams spoke with, was however limited

and, while covering quite a large fraction of actual LIST's customers and industrial cooperation partners, only a small fraction of possible industry cooperation partners in Luxembourg.

It seems to the Committee that the competencies of LIST are currently not fully and clearly articulated to potential customers and partners. This results in some confusion when multiple teams from LIST meet with these external actors. This issue could be easily addressed by having a shared vision and importantly a well-defined set of competencies owned by the different departments, units and their groups and appropriately communicated to key Luxembourgish economic players. LIST might also adopt other methods such as sending regular newsletters to clients updating them on new endeavours and expertise or to have industry days or expos.

Unfortunately, there is still little internal cooperation in LIST. More internal cooperation in LIST, in departments and across departments, may increase interdisciplinary research and innovation, e.g. the ERIN-ESA cooperation could benefit from transversal collaboration with MRT. The internal cooperation needs incentives and appropriate KPIs (e.g. specific budgets for internal cooperation projects of a strategic nature, explicit appreciation of joint publications or patents, exchange of researchers, guest researcher program, more internal contacts between departments).

The Committee became aware of a number of common themes shared by all units within a department or across departments. However, there is still a lack in overarching vision, strategy or plan with the result that work on these common themes are occasionally ad-hoc, whereas at other times a unit does not take into due consideration the expertise owned in other units. Indeed, smaller R&D institutions profit from flexible ad-hoc competence units to initiate collaborations with potential partners and stakeholders. For improving internal cooperation, MRT installed units in the so-called transversal function –programme, at present internally of the department. LIST aims at expanding this transversal function to the institute level, as for instance with the Director of Smart Cities Programs, relevant across all units of IT IS, but also for some research units in other departments. A broader portfolio/spectrum of the transversal functions at LIST level needs to be identified respecting the needs of the departments and external partners including UL.

3.3 Innovation, social and economic impact

3.3.1 Collaborative projects and contract research

Implementing the mission changes – more weight on valorisation of results for innovation – is a major operation that only started when the organisational aspects around the merger were addressed and is still in progress. The focus in the innovation strategy is on cooperation projects with industry and on obtaining IPR as a way to start (and/or support) these cooperations. In terms of technology, LIST tries to build technological lines based on reusable blocks of technology that can be applied in different fields for different customers/with different partners. Eleven (!) partnership officers have been appointed and located in the departments to identify needs of the market and develop, together with researchers, external partnerships.

The focus on collaboration projects is clearly visible. The number of these projects increased from 61 in 2015 to 160 in 2017. Income from collaborative research increased in the same time from 2.3 M€ to 5 M€ in 2017. The most important flagship project is the very large project with Goodyear (tyres), involving mainly MRT but also ITIS. Other larger examples are the cooperation with Carlex (automotive glass) and PM International (bioactive molecules for dietary supplements and cosmetics, which has led to a joint LIST/PM International lab at the LIST premises). In general, these collaborative projects are supported by Ministry of Economy (MECO), one of them has also received FNR funding. In addition, LIST provides in-kind support to these projects on the basis of block-grant financing.

Over the same period, the income from contract research and services decreased from 5.4 M€ to 3 M€. This seems to be partly caused by reducing the volume of low-value added services of LIST, but also by reduced (attention to) research as a fully paid service. This is a remarkable development, since research as a service is in many other RTO's across Europe an important part of the strategy and income, with more proactive approaches to comply with staid aid rules.

As a matter of fact, this development has been decided actively by LIST to be in line with European State Aid rules. In order to prevent any distortion of competition within the European common market, state aid remains indeed a highly controlled and regulated field (cf. Art 107 (1) of the Treaty on the Functioning of the European Union), the basic rule being that state aid is strictly forbidden. In order to avoid dire consequences, it is worth sticking to a strict compliance to the regulations.

In case of LIST, it is chosen to prevent (allegations of) state aid by preventing the consideration of LIST as an undertaking. In order to be considered an undertaking, LIST has considerably reduced economic activities like contract research and services such as routine analyses carried out in the labs, tailor-made trainings and workshops, most feasibility studies are to be considered economic activities, apart from a max. of 20% "ancillary economic activities" that are (at LIST) allowed for each department.

This means that contract research (and other service activities) must not generate more than 20% income of LIST. This is a rather low percentage for an RTO with the mission to carry out research activities oriented by the needs and interests of private socio-economic actors and translate these results into innovations that are useful and sustainable for the economy and society. In order to maximise knowledge transfer to companies (and public partners), intensive cooperation and exchange is a must, and the business model of contract research is very suitable for this.

Generally, other RTOs (in Europe) have far larger percentages of income from contract research and providing services to commercial companies than LIST (for the six large RTOs in The Netherlands, this percentage varies from 24% to 77% (TNO is at 38%); *imec* has a contract income of 82% (this includes government grants but excludes the block grant); Fraunhofer Institutes generally have 30-35% contract research income (excluding basic funding and government grants). These RTOs are all seen as undertakings, but prevent (accusations of) illegal state aid by asking prices for their services at least covering full costs (some even use value based pricing for research as a service); giving non-discriminatory access to their IPR that has been obtained with government funding, by asking market prices for this and by partnering with commercial parties on a programmatic basis (with specific contracts about shared access to IPR). All these RTOs also have extensive activities to participate in EC funding programmes. In this way there are no immediate limits to growth determined by their base funding: their limit to growth is determined by their ability to sell their unique knowledge; their ability to develop new unique knowledge and their access to good researchers.

We recommend to develop comparable strategies to deal with state aid rules.

3.3.2 IPR and valorisation

In order to professionalise knowledge and technology transfer (KTT), a legal unit has been set up as part of the CEO's office (total of 9 staff) with focus on patenting, licensing and spin-offs and legal affairs. This unit is involved with 3 KPIs in the performance contract of LIST with the Luxembourg government (Table 2). In terms of KPI performance, the number of patents submitted and the number of licenses that generated income reached the targets. The activities and outcomes increased over time and increased in comparison with the activities of Lippmann and Tudor.

Table 2 Overview of LIST's innovation KPIs and achievements (2015-2017)

	2015-2017				
	target	achieved	ERIN	ITIS	MRT
# patents submitted	40	82	21	16	45
# licences that generate income	35	37	5	28	4
# spin off companies[8]	4	3	2	0	1

Source: LIST SAR

The activities of the unit have definitely raised the attention for patenting, and a patent culture is starting to develop. The activities should be continued (although the present number of four out of nine persons in the legal unit staff in LIST working on patents is rather high and providing limited services). More entrepreneurial forces involving risk taking, linking LIST up with company or spin-off dynamics and entering in inclusively decided new niches may help to speed up innovations.

3.3.3 Impacts on companies

From the meetings of the peer review teams with (public and private) customers it became clear that LIST provides useful contributions to Luxembourg companies. In line with the research topics, most impacts are in materials and materials using industry, in the environmental business and (for ITIS) in the building sector, financial and other regulated industries.

In terms of spin offs, *OAT* (Open Assessment Technologies) is now becoming a success story. This spin-off of Tudor in the ICT for education sector from 2013 has now employs around 50 people and is planning to double in the short term. *LION* (Luxembourg Ion Optical Nano systems) has brought new SIMS analytical technology to the market. *Agro-optimize* brings tools to the market that facilitate decision-making for agriculture.

There is no evidence that LIST offers training for senior experts in industry and society as a contribution to life-long learning. After the merger this kind of service activity was deliberately diminished, being outside the scope of the LIST vision on the portfolio of an RTO. For a proper dissemination of know-how, this is an additional field of activity to be considered.

3.3.4 Impacts on policy

ERIN is the main and single actor of environmental research in Luxembourg. Holding this position constitutes a great responsibility to serve the Luxembourg government and the Luxembourg society with knowledge in this area. This requires good quality of expertise over a broad area, which the institute has proven to possess. However, there is a tension between the broad knowledge needs from society and the need for focus and critical mass to achieve international excellence in research. ERIN has proven to be able to combine both roles in the field of water, where the daily measurements for the Luxembourg government and other public partners have been used as input for valuable research. Overall, LIST-ERIN has a high contribution of knowledge to policymaking. Although many of the activities in this field have a service character, the peer review committee is of the opinion that LIST should continue to provide these services. It is suggested to bring all the service activities for the central Luxembourg government in the environmental field under one umbrella, fully financed by the Ministry of Environment, while using the block grant from the Ministry of Research for knowledge-development oriented activities.

The other departments also provide input to policymaking, or provide tools for policy information or policy implementation, but impact on policy-making in Luxembourg is still insufficient. One successful example is the GDPR Compliance Support Tool, created as part of a collaborative project of ITIS with

[8] MRT: "TailWind Lux Invest SA" (2016)
ERIN: "AgrOptimize" (2016)
"RTC4Water" (formal date of creation 02.12.2014, recorded in 2017 KPIs as activities only started beginning 2017)

the National Commission for Data Protection (CNPD), Digital Lëtzebuerg and eProseed. It has helped hundreds of companies in their preparation for the implementation of GDPR.

3.3.5 Impacts on the research and innovation system: nationally and internationally

As can be seen from the above, LIST has a distinct and valuable role in the research and innovation system of Luxembourg, as well as in the greater region around Luxembourg. The role at European level is however limited, although in some research areas the quality of the research is good enough to do so. A more international view of LIST may be suggested.

4 Organisation and management

4.1 General management

The assessment of the present management of LIST cannot be seen apart from the merger. The management challenge in LIST was considerable after the merger, and even more after the departure of the former CEO. The present CEO ad interim took up his job at a difficult moment, reduced the imminent pressure and started a lot of improvement processes. His work is to be appreciated but is not finished yet. More specific management issues are addressed below.

4.2 Administrative management and finance

4.2.1 Organisation structure

LIST as a public research centre with legal personality is regulated by the Luxembourg law on public research centres. The key ingredient in the governance is the negotiation of a performance contract between MESR and the centre, represented by its Board of Directors (BoD). The internal organisation and the ways the centre is going to produce the agreed performances, are to a large extent within the autonomy of its management.

The merger of CRP Henri Tudor and CRP Gabriel Lippmann led to a rather traditional, and at the same time proven – linear – organisational structure for LIST, with three operational departments (ERIN, MRT, ITIS), which directly report to the CEO, who in his turn reports to the BoD. The merger, with the boundary condition that no staff would be fired, also led to an overload of the organisation structure with support units and support staff (in total 127 staff)[9]. All together the relation of overhead staff to other staff is at least 1:4, this is very high and globally not efficient. On the level of the research departments, at several points it is perceived as a bureaucratic burden with limited added value.

There is a strong tendency to central decision-making and appeasement. Delegation in case of vacancies tends to more often upwards than downwards, not making effective use of the creativity and power in the organisation to deal with problems and opportunities. Vacancies at the senior management level (of which some have been open for a long-time) should be fulfilled with the utmost urgency, including a CEO representing the research face of LIST.

4.2.2 Use of institutional funding (block-grant)

As part of the performance contract with the Luxembourg government, LIST receives a block grant of (in the evaluation period) approximately M€40 each year (see Table 3 below). LIST is free in its use of this block grant, as long as the grant is spent to achieve its mission. This comfortable financial situation provides the opportunity to engage in new research domains, to finance change and to be free of the every-days stress of running after third party money. In practice, several observations call for closer attention to the amount, to related processes and to the use of core funding:

Firstly, in the years 2016 and 2017, core funding is higher than negotiated in the performance contract (EUR 39.000 EUR), whereas third party income was lower than the negotiated 25.000 EUR, representing 40% of total income. LIST did find sufficient additional funding (grants, contract income, etc.) for its activities to keep core funding at a maximum of 60%, as foreseen in the performance contract. In practice, LIST has only met the 40% income target from other sources in 2014, the year preceding the merger (Figure 3).

[9] According to information received during the peer review, this comprises the following services: (i) human resources (18 staff members); (ii) administration and finance (72 staff members), (iii) a unit called "programmes department" (6 staff members), the "CEO office" (31 staff members), in charge of central administrative services, external and internal communication, legal affairs including valorisation and the project management office.

Table 3 Overview of LIST's income: block grant and other sources (2014-2017)

	2014	2015	2016	2017
Total income (M€)	67.557	63.765	62.324	66.273
Block grant (M€)	40.497	39.078	40.103	41.133
Other income (M€)	27.060	24.687	22.221	25.140
Other income (%)	40,06	38,72	35,65	37,93

Source: LIST SAR

The three different departments differ in their performance in this respect. While MRT surpassed the target with 59% external income in 2016 and 63% in 2017, ITIS is far from reaching the target (in 2016-2017 ITIS realised only 23% external income, i.e. 77% block grant) and ERIN is close to the 40% target (40% in 2016, 38% in 2017). Block grant funding exceeding 60% for research units with a portfolio like that of ITIS is absolutely unusual in Europe. Even if the period of change partly explains this very high basic funding, it is of utmost importance to turn the relationship around, otherwise there is a high risk to disadvantage private companies.

The non-achievement of the third-party income target had no financial consequences for LIST in terms of basic funding: The government provided block grant money in excess of 60% to LIST, the amount was even higher than foreseen in the performance contract in the years 2016 and 2017. Moreover, LIST was allowed to keep funds that were not needed as a reserve for future investment. Although this may on the short term be beneficial for LIST, it does not provide LIST with the incentive to make better use of the block grant in the future.

Secondly, the strategic decision process of how to spend or invest block grants lacks transparency. Despite several request by the evaluation team, a simple and complete budgetary overview was not available on LIST level in preparation to neither during the peer review. During the review sessions it became also clear that the spending of the block grant was not sufficiently transparent for the researchers and the research management either.

As presented in the Self Assessment Report, only about 10% of the block grant was used for self-funded projects (M€ 8.8) in the last two years. 16% was used for co-funding of competitive grants from FNR or Horizon 2020. Further internal funds are needed for other types of cooperative projects: There seems to be no explicit testing of the collaborative projects or broader negotiation on the strategy before a collaboration (which always require a contribution from LIST) is approved.

Thirdly, the use of the remainder of the block grant has not been explained in the SAR in the relevant chapter. It states that "*The block grant is both the essential complement to publicly funded projects, since during the last few years the awarded grants have dropped to +/- 60-65% of actual costs, and the necessary contribution to collaborative projects. It is also used to fund internal projects ("self-funded" projects) and pre and post-project activities (meetings with potential partners, publications). (…) LIST has dedicated no less than EUR 8.8 million to self-funded projects over the last two years. For other projects and activities, however, the block grant is not allocated on a project-by–project basis.*" Looking at the overall cost structure, it is clear that the above-mentioned overstaffed administration and central services represent a considerable cost factor, together with infrastructure estimated at 35%. This severely reduces the room for creative, research enabling and research performing, use of the block grant.

4.2.3 Financial administration

The annual accounts of LIST have all been audited externally and approved. The evaluators however did not get a clear picture in adequate detail and completeness on the spending of the block grant, and also heard numerous complaints about the lack of transparency of the financial administration. This means that, although in legal terms the financial administration shows an accurate picture of the financial

situation of LIST, from the perspective of management information, there is considerable room for improvement.

The peer review did not include a detailed assessment of the financial and management information processes. The findings during the peer review however suggest that most of the budgeting is based on historic path-dependencies and not sufficiently on strategy and performance, apart from the limited investment in own projects.

The inability to provide comprehensive and analytical profit and loss accounts at department level, also suggest that the budgeting (and reporting) is done at a fairly high level of aggregation (e.g. FTEs per research unit) and not on the level of groups and projects. In addition, data access is available only on the overall management level, and not to department managers. This is an unusual situation for professional organisations, and the lack of information makes effective management (i.e. realising the maximal scientific and socio-economic impact) of the organisation difficult.

LIST claims to incur full costs when collaborating with industry and indicates that their cost prices have been approved by the European Commission. The cost-price calculations as shown to the peers are approved rates for H2020 (aimed at minimising EC costs in H2020), not a full cost model aiming at (at least) recovering costs when providing research services. These rates are in the eyes of the peers not sustainable for an RTO, because, amongst others, they do not include realistic overhead costs and assume staff work for 100% of their time on projects.

All in all, and combined with high overhead costs, there seems to be a lot of room for improvement of the financial administration at LIST, both in terms of effectiveness and efficiency.

4.3 Human Resource policy and performance

4.3.1 Post-merger effects

Following the merger, LIST has undergone a difficult transformation process, with changes that affected the HR functions: the merger of some units including corporate functions, the closing of some of its research units, the termination of some activities (e.g. health technology, certain ICT services) and many management changes. These changes, combined with difficulties in fulfilling many management positions (including for quite a while the position of HR director) and a lack of change management and (unified) HR policies, have led to severe staff dissatisfaction, despite attention to avoid harsh effects on employees. This has not been completely dissolved, and still causes problems. Estimations of interview partners vary between 15-30% of staff suffering from post-merger developments, referring to lack of self-confidence, loss of trust in the institution, missing corporate view and culture, weak inter-unit and inter-department collaborations, absence of homogeneous communication to the outside world and competition of several LIST units on the same potential PPP or project. At the same time, there are promising new research units that have been created after the merger with engaged and highly motivated staff. The recent recruitment of a HR director is an important step in the right direction to deal proactively with remaining problems.

4.3.2 Recruitment

A visible effect of the merger and related reorientation of the institute was the reduction of staff by 20% between 2014 and 2016: for 75% reduction in (temporary research) staff. With very few exceptions, no fixed-term contracts were terminated prematurely. The recruitment figures for 2017 show that LIST has managed to reverse the downsizing trend with an increase in staff with over 50 persons, allowing it to regain its original workforce.

In general, the three departments have been successful in recruiting talented and competent people. However, for some research units, scarcity of staff with the right competences and high international competition make it difficult to recruit new skilled people. This is further aggravated by the currently excellent job perspectives of people with respective qualifications in competing companies and organizations, some of which also having more flexibility when negotiating salaries. Specific attention

needs to be paid to this issue, since a strong management is needed to bring LIST further and too many management positions are not fulfilled at the moment.

LIST has a good and truly international staff, but experts are of the opinion that the institute does not yet have the critical mass of collaborators to face the need of additional expertise in areas of growth and to ensure its sustainability. The workforce is still too dispersed across expertise fields and the stronger market orientation underpinning the RTO vision implies a need for people who know the market, are curiosity driven and are able to align strategy, technology and market that are not yet in-house. Under the guidance of the new CEO, LIST should identify a few fields for focus and a few senior candidates to repeat the positive FNR-PEARL experiences of the past.

4.3.3 Gender balance

The institute shows an unbalanced gender distribution with 25% of female employees, and a low number of female leaders, except at the BoD. This situation is widespread in the scientific and technological domains LIST is active in. With respect to gender balance in management positions there are variations between departments, ITIS having two research groups and the SIA team being led by women, whereas management of ERIN and MRT mainly consists of men. With respect to the overall gender balance in the workforce of ITIS, with 25% women, the situation is comparatively good given the general gender ratio in the IT business world. It leaves room for improvement in ERIN (35%), particularly within the permanent research staff and management, and MRT (22%), with the lowest percentage of women. Leadership is conscious that percentage is low, but it is important to point to the observation that gender policy in LIST is mainly understood as a question of gender distribution. There is rather poor understanding of broader approaches of gender mainstreaming and so far, no gender policy in place.

4.3.4 Career management, PhD training

Statements from researchers interviewed reveal uncertainty concerning their career paths and promotion possibilities. A first LIST collective agreement was signed in 2017, addressing this issue, implementation is on the way. It defines the different professional categories at LIST, the associated remunerations and their possible progressions within each category. This is a first step towards providing a global vision of the possible career lines for LIST employees and of the HR management support that LIST can offer to each individual staff. Experts recommend developing a dialogue procedure and the necessary instruments to assist LIST employees in developing their own career plans. These are necessary conditions to reinforce trust and corporate adhesion and to increase LIST sustainability.

The PhD policy put in place works well. The departmental peer review teams had a personal exchange with selected postdocs and PhD. The general feedback was very positive. PhD students and postdocs demonstrated high level of satisfaction with their scientific work, the infrastructure and their supervision. PhD training is also well appreciated. This includes trainings offered by LIST and soft skills courses at UL (also for PhDs at LIST that do not defend their thesis at UL). PhD students however, regret the absence of career plans. Those who would like to pursue an academic career consider the limited options to teach as a disadvantage. The ones involved in PPPs that like to remain in industry suggest promoting an Alumni association to develop an efficient professional network.

4.3.5 Other

While the participation to EU projects enhances LIST's international anchoring and cooperation, experts are of the opinion that exchange of researchers with other European research centres and organizations have not been a focus so far. This might be an important subject for the upcoming years and experts recommend extending networking at European level. This will permit to augment LIST visibility, make LIST attractive for new scientists and facilitate its participation to EU collaborative projects. In addition, temporary exchange of employees with partner institutions and sabbatical leaves should be promoted.

4.4 Physical infrastructure and working conditions

LIST is momentarily located on four sites. The building on the Belval campus which hosts ITIS and the corporate services is new and in an excellent state. This clearly contributes to the attractiveness of LIST as an employer and institution. The Belvaux building adjacent to the Belval campus is a bit older but in very good shape. The Hautcharage (recently completely renewed) and Foetz (not visited during the peer reviews) buildings are located several kilometres away. In the SWOT analysis this is considered a major weakness. In the opinion of the peer reviewers the cultural distance between the sites seems to be larger than the distance in meters. The situation is considered as being manageable and can be overcome with an increase in cooperation projects and more interaction between locations within LIST. There are some complaints about lack of office space and/or lack of quiet working places. This should be addressed with a creative and flexible approach.

The technical labs, which were presented during the peer review, are spacious and demonstrate state of the art installations that provide adequate and sometimes (e.g. data analytics platform, composite centre) advanced support for researchers. The research infrastructure is considered as very good and, in parts even excellent.

For some more advanced needs, e.g. for high resolution microscopy and spectroscopy, cooperation with UL (in this case the Physics and Materials Science Research Unit PhyMS) and/or other institutes exists and should be developed further. Access to large scale facilities like Synchrotron Light or Neutron Sources exists but is rarely used.

The facilities are very well managed: not only in technical terms but also in terms of availability of staff capable of using the facilities. Procedures for workers safety are there and seem to be enforced. There are some complaints about time and bureaucracy to get access to the instruments.

Access to scientific papers and patents and other literature is arranged in a national research network with the UL. According to the LIST management, this works without hurdles.

Young researchers and PhD students feel well supported by their departments. The high level of financing from the block grant, reducing the need to get in external funding, is well appreciated.

Overall, working conditions of scientists and technical staff at LIST seem to be attractive, competitive and appropriate compared to international standards.

4.5 Research and innovation culture

Finally, experts wish to raise the question of Responsible Innovation (RI), which they consider important for an RTO. Currently LIST has some aspects of RI embedded informally in their practices. For example, at ITIS there is a strong orientation to producing research and innovations that protect customers' privacy and security, both of which are essential to good research and RI. Also, ERIN has a strong focus on decreasing environmental impact. The Committee suggests going beyond departmental initiatives and recommend developing RI practice more formally in the future to ensure the ethical and societally acceptable production of LIST's innovations.

LIST participates various forums, international exhibitions, science festivals and has made a lot of efforts to present its activities to the public thanks to the showroom in the entrance of the building in Belval. Still, there in order to increase its impact, science communication to a larger public could be increased.

Open Science was not an issue of discussion at the LIST peer review. Although this is somewhat of importance for LIST, the Committee suggest addressing this at national level, led by FNR and UL.

5 Governance

As for all CRP, MESR selects the members of the Board of Directors (BoD, nine in case of LIST) of LIST. The composition of the BoD is approved by the Council of Ministers. MESR is represented in the BoD by the Government Commissioner, a civil servant that is non-voting member, mainly in charge of supervising and ensuring legal obligations.

Every four years, MESR negotiates a performance contract with the BoD. MESR delegates the supervision of the implementation of the performance contract to the BoD. Overall, during the implementation of the performance contract, MESR acts mainly hands-off.

MESR has delegated many important and powerful roles to the BoD: the negotiation of the performance contract and the supervision of its implementation, a key role in hiring top-management, setting strategies and financial plans and approval of annual reports. As we understand from the discussions during the institute level peer review, the BoD meetings include a lot of operational management issues as well.

The CEO is responsible for the actual management of the CRP. The effective power of the CEO is larger than the formal power: The CEO with his or her team negotiate the performance contract directly with MESR, the BoD only approves it. For the review of the implementation of the performance contract there are annual meetings between MESR and the CEO directly.

The Committee is of the opinion that working with a multiannual performance contract is suitable for LIST. It provides LIST with longer term financial stability necessary to develop and implement a distinctive strategy, and, with the right KPIs, it also provides the opportunity for MESR to stimulate LIST to contribute to MESR policy goals.

A session of just over one hour with two Board Members, and a limited number of referrals to the Board in the other sessions, is not enough to get a full picture of the governance of LIST. However, it still shows that a clear process for strategy formulation at LIST including the roles of MESR, BoD, CEO and Department Directors is missing and the mechanisms to monitor the implementation of the strategy are insufficient (e.g. LIST was not able to provide a complete record of the use of the block grant to the peer reviewers).

The following observations are made with respect to the roles of the three key players in the governance of LIST, which require a closer look:

- With respect to the role of the CEO:
  - The formal role of the CEO is at present limited, and the relation vis-à-vis-the Board seems not always crystal clear. It is suggested to strengthen the operational and strategic role of the CEO. However strong CEOs also require strong controlling BoDs, with clear procedures, complete, transparent communication and critical assessment of plans and performance as part of a relation build on trust.
- With respect to the role of the BoD:
  - The formal role of the BoD is very large, however in practice, a lot of this power is delegated to the CEO. This is useful: The time that part-time BoD members can spent on their CRP is less than the time a full time CEO and his/her team can spend, although those we have spoken to are very committed to LIST. The BoD should be more explicitly supervisory (in charge of checks and balances) and less operational, in practical and (this probably needs a change in the law) also in formal terms.
  - The BoD should have the capability to open doors to 'problem owners' at political (public) or Board (private) level.
  - The profile of the members of the BoD and their nomination procedure need to be in line with this new role.
- With respect to the role of the head of departments:

  - Head of departments have an important role in defining and implementing vectors of success of the entire CRP. They have to be involved in the strategy process and have access to internal monitoring systems.

- With respect to the role of MESR:
  - The development of a detailed strategy is the responsibility of the BoD and CEO. MESR should not try to have a large influence on the strategies (only at high abstraction level, e.g. more attention for the problem of climate change; stronger focus on translational research; focus on financial sector. However, they should require the presence of an explicit strategy about a year before the performance contract end, is taken into account as ex-ante part of an external evaluation of the previous period and is, in its final form, part of the performance contract.
  - The KPI targets for science and innovation seem not sufficiently in line with the ambition that MESR has with LIST: becoming a top research institute having a societal impact. KPI are rather science focused, business performance indicators are only integrated to a limited extent. The level of KPI targets seems history based and not very ambitious or challenging. Moreover, there are no consequences of underachievement or overachievement with respect to the KPI targets. Such rewards and penalties can have a huge motivating impact.
  - The dual role of MESR as 'principal' and as observer in the BoD has advantages (good information flows, close relations) but is in other countries sometimes seen as undesirable (possible conflict of interest for government commissioners between their role as civil servant and their role as Director).

6 Conclusions and recommendations

6.1 Conclusions

1. LIST started its activities in January 2015 as a merger of the research centres Lippmann and Henri Tudor. The peer review committee is of the opinion that the decision to form LIST was a right decision from the Luxembourg state perspective and the added value starts to be realised. So far, LIST has not yet developed into a smoothly running RTO however; because of differences in focus between the two former CRP, arising leadership issues and other managerial problems, the first few years of LIST that are covered in this evaluation (2014-2017) were difficult and challenging years.
2. According to the law, "LIST's specific mission is to carry out innovation and scientific research activities oriented by the needs and interests of public or private socio-economic actors…" The short term, CEO of LIST interpreted this mission as that it should perform R&D activities with a focus on TRL3-7. A TRL-approach is useful to describe advancements in a purely technology development project in direction of marketing, however, inappropriate and internationally unusual in mission/vision statements of **S**cience and **T**echology institutions like LI**ST**. The better equilibration of research for knowledge generation versus valorisation of research and impact and the introduction of TRL for specific issues had a positive impact in LIST, as it increased attention to stages of maturity from research to implementation and stimulated entrepreneurial esprit. The TRL 3-7 focus at LIST should not be interpreted as a limitation to TRL 3-7 activities alone, because such a limitation would be inappropriate for the mission of a Science and Research Institute, as it would neglect scientific excellence and would set insufficient incentives to demand-side driven innovation projects. For development and service projects in close collaboration with customers the assetisation cycle "Asset-ise, deploy, and learn" seems better suited.
3. LIST had received slightly more than 60% block grant, provides LIST with a solid financial foundation and the opportunity to engage in new research domains, to finance change and to be free of the every-days stress of running after third party money. A future-oriented, dynamic development of LIST is somehow hampered by contradictory incentives set by this very generous basic funding, especially due to a general ceiling in contract research of 20%, to avoid the positioning of LIST as an undertaking, in compliance with European state aid rules.
4. The spending of the block grant is not fully transparent and only for a small part used for internally defined and performed research programmes and projects (which is what base funding is used for in many other RTOs with significant public funding). This undermines a growth-oriented thinking and acting both at top level as well as department level. Budgeting (and reporting) seems to be done at a fairly high level of aggregation. The lack of information on department and unit level makes effective management of the organisation difficult.
5. Additional income from competitive sources and contract research represents 37% of total financing over the years 2015-2017, and lacks behind objectives defined in the performance contract (40%): Especially ITIS is far from reaching the target (in 2016-2017, ITIS realised only 23% external income). ERIN is close to the 40% target (40 % in 2016, 38% in 2017), while MRT surpassed the target with 45% external income. The non-achievement of the third-party income target had no financial consequences for LIST in terms of basic funding: The government provided block grant money in excess of 60% to LIST. Although this may on the short term be beneficial for LIST, it does not provide LIST with the incentive to make better use of the block grant in the future.
6. The evaluations of the three departments show that there is a medium to high quality of research activities already in many areas (ranging from 'a national player' to 'internationally leading'), and a high potential for further development and international deployment in most domains. At LIST there is still room for a more focused thematic scope on the one hand and for more spatial deployment on the other, notably on the international level.
7. Cooperation and networking between UL and CRP are of great importance for Luxembourg as a small country and for LIST. Networks in Luxembourg are well developed, although the relation between ITIS and UL-SnT requires attention. Stakeholders from industry express a high degree of

satisfaction with the services of LIST. There is still limited internal cooperation in LIST. International cooperation leaves room for improvement.

8. A valorisation unit has been set up at LIST. The activities of the IP unit have definitely raised the attention for patenting, and a patent culture is starting to develop. The number of patents has sharply increased and a (small) number of spinoff companies is becoming successful.
9. The main impact of LIST on policy is at ERIN. ERIN is the main actor of environmental research in Luxembourg. There is a tension between the broad knowledge needs from society and the need for focus and critical mass to achieve international excellence in research. Societal challenges and impact for the Luxembourg society are not yet sufficiently addressed in the strategy of LIST as a whole.
10. LIST achieved most of its present KPIs (set aside third-party income), however the questions arises whether the present KPIs are the most suitable KPIs for LIST and whether the targets are at the right level of ambition. KPIs for valorisation/KTT need to be developed.
11. In organisational terms there are a number of issues. The merger, with the boundary condition that no staff would be fired, led to an overload with support units and support staff (in total 127 staff), all together, the relation of overhead staff to other staff is at least 1:4, this is very high, globally not efficient, and probably consumes a considerable share of the block grant. On the level of the research departments, at several points it is perceived as a bureaucratic burden with limited added value. Crucial (Senior) management functions have remained vacant for quite some time. In general management processes there is a strong tendency to central decision making and appeasement. Delegation tends to more often upwards than downwards, not making effective use of the creativity and power in the organisation to deal with problems and opportunities.
12. The organisational consequences of the merger combined with difficulties in fulfilling many management positions and at most a week change management and (unified) HR policies, have led to a severe staff dissatisfaction within estimated 15-30% of staff, that has not been dissolved and still causes problems. These problems need to be solved at the level of a corporate culture with shared LIST goals, more self-confidence and more inter-department cooperation. A start has been made to do this.
13. Recruitment at LIST does not meet more serious difficulties than are normal to the labour market. The institute shows however an unbalanced gender distribution and in particular a low number of female leaders, except at the Board of Directors. There appears to be no comprehensive policy concerning gender. A general framework for careers and promotions within LIST was missing, and start to be implemented based on a first LIST collective agreement signed in 2017. The PhD policy put in place works well.
14. Research facilities at LIST are good and are very well managed: not only in technical terms but also in terms of availability of staff capable of using the facilities. Overall, working conditions of scientists and technical staff at LIST seem to be are attractive and competitive, appropriate compared to international standards.
15. In terms of governance, the multiannual performance contract is a suitable instrument for MESR to steer LIST. It provides LIST with longer term financial stability necessary to develop and implement a distinctive strategy, and, with the right KPIs, it can also provide the opportunity for MESR to stimulate LIST to contribute to MESR policy goals.
16. There is an imbalance in the supervision of LIST within the MESR-BoD-CEO triangle, resulting in a lack of supervisory responsibilities. The key bottleneck is not in the way it is organised, but in implementation.

6.2 Recommendations

6.2.1 Recommendations for LIST

17. One and only one mission statement should be elaborated and communicated. This should clarify the positioning of LIST as a science-technology-innovation institution and consider adapting the

mission so that it gives a clearer action perspective for LIST staff. Mission/vision statements of similar science-technology-innovation institution might be considered. Strengthen visionary leadership with clear ambitions related to mission, megatrends and opportunities.

18. Under the guidance of the new CEO, LIST should identify a few fields for focus and a few senior candidates to repeat the positive FNR-PEARL experiences of the past; encourage talents to compete again for an ERC grant. Increase the focus on research and innovation across all departments, and prioritise and posterioritise, in order to gain in critical mass and increase its (international) impact in science and on the market and to make room for emerging research themes as well. Continue to strengthen the coherence of the national Education-Science-Innovation-Service players for their national and international visibility. Incentives should be provided.

19. The domains of LIST are dynamic and prone to change and thus demand a dynamic research strategy. Develop a structured process for strategic decision-making, at institute level and (in a coordinated way) at department level in order to realise this increased focus. Set up external scientific (and maybe societal) advisory boards in order to support this process and (after the strategy formulation process) support in implementing the strategy and monitoring the impacts. A smoother – and profitable – responsiveness to users' demand should help clarifying strategy and focus of LIST.

20. Implement the strategy by making strategic use of the block grant. This is THE main challenge for LIST for the next years. The concept of "co-funding grants" should turn into a "cost contribution" thinking. Start with the strategy and then implement the strategy by using the block grant to deliberately agree upon collaborations and attract grants and contracts. Overall, the CEO should be the "owner" of the block grant, supervised by the BoD, and thus responsible for its use and the reporting on it. As frequent advisor to the CEO a Research Committee (with external and internal members, linked to the advisory board) should be established to evaluate regularly new internal R&D&I project proposals.

21. The block grant should be attributed in a transparent way, (at least partly) by means of multiannual budgets along longer-term strategic lines. Support the implementation of the strategy with a certain amount of autonomy for the departments, incentives to use the block grant to acquire more external research funding and adequate administration to provide the right management information.

22. Taking into consideration European State Aid rule, comparable strategies to other European RTOs should be developed to adopt a business model that provides positive incentives to offer research service to customers on a real and full cost basis, next to collaborative projects and competitive funding.

23. Integrate and rebalance the support functions, to be focused to fit with the size of the research activities and the needs of the primary process. The leaner and more flexible administration and treating departments (or even research units) as budget units with an own responsibility for income, costs and results (including non-financial results) could be part of the implementation.

24. Improve HR at the level of a corporate culture with shared LIST goals, more self-confidence and more inter-department cooperation. Fill the management vacancies, develop a career development plan system and develop an explicit gender policy (including a programme to attract female researchers and female experts for leading positions within LIST).

25. Strengthen internal cooperation with incentives and appropriate KPIs. Incentives include specific budgets for internal cooperation projects of a strategic nature, explicit appreciation of joint publications or patents, exchange of researchers, guest researcher program, more internal contacts between departments). Platforms with a transversal function as installed in MRT may provide a useful organisational model, and may even include selected teams of UL and possibly LIH and LISER.

26. KPIs need to be defined so that excellence of research as well as transfer and valorisation of knowledge and their national, respectively international relevance have appropriate weight. Other KPI should relate to internal cooperation, thematic focussing and career plans, including gender related policies.

27. Continue the activities in the field of valorisation, however not considering patents as a goal in itself, but with appropriate attention for patents as a means to generate knowledge transfer and business.

A more entrepreneurial approach involving risk taking, linking LIST up with company or spin-off dynamics, and entering in inclusively decided new niches may help to speed up innovations.

28. Continue to provide services in the environmental field, even though many of these activities do not have a research character. Try to bring all these service activities for the central Luxembourg government in the environmental field under one umbrella, fully financed by the Ministry of Environment, while using the block grant from the Ministry of Research for knowledge-development oriented activities.
29. Work actively on a change of culture across LIST, from the top (BoD, CEO and management team including heads of departments) to the bottom of the organisation: work on values (e.g. rewarding over-achievement and penalising under-achievement), attitudes (e.g. entrepreneurship and leadership over administration) and routines (e.g. the agenda of the regular meetings of the BoD).

6.2.2 Recommendations for the Luxembourg Government

30. Reward (provide incentives for) complementary cooperation between the national players of higher education, research and innovation for the better international visibility of Luxembourg
31. Adapt KPIs of LIST to better reflect the RTO role LIST is intending to have. Consider rewards when (ambitious) KPI-targets are met and penalties when KPI targets are not met, including third party financing. Clarify necessary incentive structures in KPIs to stimulate LIST to act both as a research service provider, and as research partner for companies and other organisations.
32. Empower the BoD and the CEO of LIST by more systematic interaction on the use of the block grant with the BoD of LIST, both forward looking in terms of strategies and plans, as well as backward looking in terms of reporting about implementation. Consider, with the BoD, the establishment of an external advisory council to support the CEO.

Appendix A Members of the Assessment Committee

Prof **Louis Schlapbach** (Switzerland) is Prof.em. Physics of ETH Zurich and former professor at the Université de Fribourg. As Director of Empa (2001-2009) , a Materials Science and Technology Institution of the ETH Domain with 800 co-workers in Dübendorf-Zurich, St. Gallen and Thun, he successfully transformed the former materials testing institution into a modern materials research and technology laboratory.

His research interests mainly concern nanoscopic properties of new materials and their surfaces/interfaces, hydrogen interaction with solids, and more generally materials for energy technology, with a focus on use inspired research. His NATURE-paper "Hydrogen-storage materials for mobile applications" (414, p. 353, 2001) was cited more than 5000 times, and the Springer books "Hydrogen in Intermetallic Compounds I, II" were quickly sold out. The Web of Science yields 380 publications with an average citations >30 and an h-Index >55.

Louis Schlapbach was Member of the Research Council of the Swiss National Science Foundation SNF from 1997 to 2004; from 2009-2015 he presided the National Research Programme „Smart Materials". From 2010-2016 he was Member of the Helmholtz Senat (Germany) from 2009-2018 he worked for the National Institute for Materials Science (NIMS), Tsukuba (Japan), as a part time scientist and as International Advisor of their WPI nanoscience programme MANA. He works as an expert of the Swiss Innovation Promotion Agency Innosuisse as well as for various international research promoting and evaluating agencies like the Agence Nationale de la Recherche ANR (France), the Fond National de la Recherche FNR Luxembourg, Cariplo (Lombardia, Italy), Technopolis (UK), and Interface (Switzerland). He is Honorary Member of the Swiss Physical Society and Member of the Swiss Academy for Technical Sciences.

Colette Rolland is Professor Emeritus at the University Paris1 Panthéon-Sorbonne. Her research interests lie on topics such as conceptual modelling, methodologies and CASE tools, method engineering & CAME tools, requirements engineering, business process modelling, co-evolution, IS and business alignment and change management. She has been involved in a large number of European research projects and she is used to lead cooperative research projects with companies. Colette has an extensive experience in supervising PhD theses (110); she published about 350 reviewed papers in Journals and Conferences, cumulated 10000 citations, has been editor of 30 Conference Proceedings, is member of the board of 10 International Journals and has delivered more than 60 keynote talks in International Conferences. She is an IFIP officer, IEEE member and received several awards such as IFIP Silver Core, IFIP service Award, Franqui's Foundation award (Belgium) and European award of 'Information Systems'. She is Doctor Honoris Causa of the University of Geneva.

Agr.Ing. and Dr from Institut National Agronomique Paris-Grignon (France), Dr **Marc Benoit** is senior scientist in INRA (French institute of agricultural researches) in SAD department (Science for Action and Development). In this multidisciplinary department, he is in charge of co-management of the agronomists (42 researchers). After a Ph.D. on land management by farmers, his research activities are focusing on landscape agronomy and water quality protection at watershed level. He has focused his research activity on land use dynamics, and more specifically on spatial organisation of land changes in mixed and agricultural landscape. He is co-manager of an interdisciplinary research

group (“E_LTSER Moselle”) on the Moselle watershed (18 research teams) and working on the AGREV DT project (Agriculture For Water Protection on Vittel-Contrexeville watershed). He chaired the 3rd division of European Society for Agronomy “cropping system form farm to global scale” until august 2014 and is president of French Association for Agronomy. He is member of Scientific Council of Seine-Normandy watershed Committee and president of the Scientific Council of Rhine-Meuse watershed Committee. He authored or co-authored 69 peer-reviewed scientific publications and 91 communications in international conferences.

Appendix B Site visit programme

Day 1 - October 08th

Time	Programme	By
11.30 - 12.00	Arrival at airport/train station	PR+TP
12.00 - 13.00	Transfer to LIST	PR+TP
13.00 - 14.30	Over sandwich lunch Recap of department evaluations finding; Identification of main discussion points; Reporting format, work distribution	PR+TP
14.30 - 15.15	Presentation of LIST valorisation strategy (max. 15 min), followed by discussion	Relevant staff: TTO-staff, staff focused on PPP-organisation, …
15.15 - 15.30	Tea/coffee	
15.30 - 16.30	Presentation: mechanisms for distribution of block grant (max. 15 min), followed by discussion	CEO & Finance director
16.30 - 17.00	Discussion on HR policy and issues (no presentation)	HRM director
17.00-17.15	Tea/coffee	
17.15 – 17.45	Group discussion with Collaborative Council (no presentation)	(Representation of) Collaborative Council
17.45 – 18.30	Group discussion with Staff Delegation (no presentation)	(Representation of) Staff Delegation
18.30 - 19.15	Recap/Draft conclusions on the first day	PR+TP
19.00 – 20.00	Transfer to hotel	PR+TP
20:00-…	Dinner	PR+TP

Day 2 - October 09th

Time	Programme	By
08:15 - 8:20	Transfer to institute	PR+TP
08:20 - 08:30	Photo in showroom	Institute director+PR+TP
08.30 -08.50	Institute strategy, past and future: 10 min presentation on most important decisions in evaluation period (and impacts of those decisions) and 10 min on important strategic issues at the moment	Institute director, staff directors, department directors
08:50 - 10.30	Discussion	
10.30 - 11.00	Tea/coffee, preparation of discussion with the Board	PR+TP
11.00 - 12.15	Discussion with Institute Board of Directors (no presentation)	Institute Board of Directors, including Government Commissioner

Time	Programme	By
12:15 - 13:00	(simple) Lunch	PR+TP, Institute director, staff directors, department directors, Institute Board of Directors
13:00 - 14:45	Draft of preliminary conclusions	PR+TP
14:45 - 15:00	Tea/coffee	
15.00 - 15.45	Presentation of preliminary conclusions and discussion of possible recommendations	To Institute management and institute Board of Directors and client (MESR) and others if considered suitable by institute
15.45	End of programme, transfer to train station/airport	

Appendix C Questions for LIST evaluation (from terms of reference)

1. **Mission, goals and strategic plans of LIST:** The evaluation shall review the mission and goals of LIST and how the CRP lives up to these. The mid- and long term plans shall also be evaluated regarding their existence, their ambition and whether they can be reached. The *scope* of LIST shall also be analysed; i.e. the actual and potential outreach beyond the small Luxembourg home ground, as discussed in the following topics 2. to 4.

2. **Research performance:** The evaluation shall assess first the clarity, uniqueness and ambition of the research agenda. In a next step it shall evaluate the quality, output and impacts of the research being performed in the departments and units of LIST and put these into perspective with the record of comparable socio-economic research centres in Europe. Further, the evaluation shall assess how and how strongly LIST is participating in mission-oriented research and is able to contribute to the tackling of societal challenges on national and international level. The appraisal of critical size of research activities shall be included here also; as well as progress being made towards joint publications, stronger research intensity and improvements in FNR (e.g. PEARL) and EU (e.g. ERC) grant record. This topic is in close relation to the relevance criterion (topic 3.). The evaluation of the research output, the impact and the ability to renew the knowledge base shall be done for each research unit and department and be rated clearly in an appropriate way.

3. **Innovation performance:** The evaluation shall assess all the different forms of innovation and value creation activities of the centre, including applied research work, contract research, provision of public data, membership in international committees, transfer activities, services, attractiveness of the physical infrastructure and related topics. This evaluation task also encompasses policies and support actions like strategies for the dissemination of results to companies and society and other action. Again, the evaluation shall analyse the mission orientation, quality, output and impacts of the innovation activities on all levels of LIST and it shall put them into perspective with the record of comparable socio-economic research centres in Europe.

4. **Role as a national and European evidence provider**: The evaluation shall assess the specific role and performance of LIST as a national and – where applicable – European data and expert study provider for evidence -based policy. The evaluation shall rate the quality of the underlying databases and data banks, see also para. 9.

5. **Users, networks and user access:** The evaluation shall further assess whether the "real world" contacts of LIST are substantial, yielding and resilient. This includes an analysis of the relevant international networks of the centre and the embeddedness in European consortia. In this context and given the small size of Luxembourg this includes the analysis of the relevant markets, i.e. whether LIST is more a local or an international player.

6. **Collaboration with Luxembourg research actors:** The evaluation shall describe and appraise the research collaboration patterns with the other two CRPs and the University of Luxembourg (UL), both quantitatively and qualitatively. The evaluation shall use the Common Strategy Paper 2016-2025 of the three CRPs and UL as one important source for the assessment of intensified collaboration patterns. The evaluation shall further review the positioning of LIST with regard to the growing and now sizeable university UL, including the complementarity of research approaches. Past achievements and challenges shall be evaluated as well as future potentials.

7. **Human Resource (HR) policy and performance:** The evaluation shall include a review of recruitment and career policies and the performance of key staff. The issue of PhD training (together with UL and other organisations) shall be evaluated, as well as matters of internal and external training and the supply of life long learning courses for industry and society.

8. **General working conditions and infrastructure:** The evaluation shall consider if LIST offers its researchers the intellectual, organizational and material working conditions that are internationally competitive and can be justified to the taxpayer. This includes also the infrastructure as well as the general support structures of the centre. Regarding infrastructures, the evaluation shall also review the business model, operating modes, responsibilities and user access, further the existence and functionality of core facilities (for internal use and as external services).

9. **Campus:** The evaluation shall review whether the LIST premises are appropriate but also well used and supportive to intra- and inter-organisational collaboration. This is especially important for the new location in Belval.

10. **Governance:** The evaluation shall analyse the relevant governance structures, both within the centre and in relation to MESR and the government. This includes also funding matters, the level of achievement regarding performance indicators and the dealing in case of underperformance. In this topic the evaluation shall also review and discuss the ability of LIST to contribute to national priority setting.

11. **Management and organisation, incl. budget:** In this broad evaluation task a number of topics shall be evaluated, including the management structure, the quality of decision making processes (including management in case of a crisis), the use of the granted financial and organisational autonomy according to the law, the budgeting processes, the financial record and sources of income, the installation of proper quality management systems and related points. Another topic to be evaluated is the appropriateness of the inner structure of the centre and the leadership performance on all levels, i.e.

centre, departments and units. The evaluation shall review the capability (on all levels) to implement and develop the research agenda of LIST.

12. **Research and innovation culture:** The evaluation shall take into account questions of research and innovation culture like RRI, open science and innovation, public and community engagement, ethics, public understanding of research and comparable activities.

13. **Overall assessment:** An overall assessment shall be provided.

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