



# **Report on the evaluation of the Luxembourg Institute of Science and Technology (LIST)**

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**I Authors**

Stefan Rieder

Nicolas Grosjean

Chiara Büchler

**I INTERFACE Politikstudien**

Forschung Beratung AG

Seidenhofstrasse 12

CH-6003 Lucerne

Tel +41 (0)41 226 04 26

Rue de Bourg 27

CH-1003 Lausanne

Tel +41 (0)21 310 17 90

[www.interface-pol.ch](http://www.interface-pol.ch)

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# 1. Introduction

The Ministry of Higher Education and Research (MESR) in Luxembourg mandated Interface Policy studies Research Consulting, Switzerland to organise and lead an evaluation of the performance of the Centres de Recherche Publics (CRPs) in Luxembourg in the period from 2018 to 2021. In this report, the overall results of the evaluation of the CRP Luxembourg Institute of Science and Technology (LIST) are summarised. The report is based on peer reviews of LIST's departments, a bibliometric analysis, interviews with representatives of LIST's governance bodies and a benchmark analysis with an international research institution. In this chapter, we present the framework of the evaluation, including its overarching objective and methodological approach, and give a brief description of the institute.

## 1.1 Framework of evaluation

The Grand Duchy of Luxembourg operates three non-university public research and technology institutions defined as Centres de Recherche Publics (CRPs): the Luxembourg Institute of Science and Technology (LIST), the Luxembourg Institute of Health (LIH) and the Luxembourg Institute of Socio-Economic Research (LISER).

The overarching tasks of the CRPs are defined in the law of 3<sup>rd</sup> December 2014 (the CRP law).<sup>1</sup> As stipulated in the law, the CRPs' mission is to carry out targeted basic 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. The detailed activities and objectives of the CRPs are defined in four-year performance agreements between the Ministry of Higher Education and Research (MESR) of Luxembourg and the individual CRPs.

### 1.1.1 Objective

The overarching objective of the evaluation is to assess the three CRPs and their research and transfer performance in the period 2018–2021. This can be broken down into three sub-subjects, namely input, output and outcome/impact:

- The *input* includes the preconditions for the research conducted, such as strategies, financial and human resources, infrastructure, organisation and external collaboration.
- The *output* includes the research performance, exemplified through research and innovation results and their dissemination.
- The *outcome/impact* refers to the medium- and long-term effects as well as the relevance of the output on areas such as science, society, economy and public administration/politics.

The three sub-subjects of the evaluation are examined at the level of the departments of the three CRPs. Each department evaluation is summarised in a *department report*. Subsequently, an aggregation of the departmental evaluations is carried out, resulting in individual *institute reports*. Based on the department and institute reports, the entire sector of CRP research in Luxembourg is assessed in a *synthesis report*. Through the identification of the CRP's strengths and weaknesses as well as the opportunities and

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<sup>1</sup> Loi du 3 décembre 2014 ayant pour objet l'organisation des centres de recherche publics: <https://legilux.public.lu/eli/etat/leg/loi/2014/12/03/n2/jo>, last accessed: 27.10.2022.

challenges, the aim is to contribute to improving the input of the CRPs in order to optimise their research and transfer performance.

### 1.1.2 Methodological approach

The evaluation is based on a combination of methodological approaches:

- *Departmental peer-reviews*: For each department within the three CRPs, a peer-review was conducted. The departmental peer-reviews consisted of a self-assessment report written by the CRPs and the departments and a hearing at the departments in August/September 2022. The hearings were organised and moderated by Interface and carried out by group of experts working in the departments' research fields. Each hearing comprised a presentation by the department, a group discussion of the self-assessment report and several individual and group interviews. These included interviews with representatives from the management teams and members of the research staff as well as clients. The experts of the peer reviews and the evaluation reports are listed in Appendix A 1.
- *Bibliometric analysis*: A bibliometric analysis was carried out in order to determine the positioning of the three CRPs in comparison to their international academic peer community. The analysis was carried out at the level of the 11 departments and was based on academic publications in 2018–2021 as well as on a collection of publications that served as benchmarks.
- *Field-Weighted Citation Impact (FWCI)*, indicating how the number of citations received by the institution's publications compares with the average number of citations received by all other similar publications in Scopus.
- *Outputs in Top (10%) Citation Percentiles*, indicating the extent to which an institution's publications are present in the top 10% most-cited percentiles (by SciVal's CiteScore).
- *Publications in Top (10%) Journal Percentiles*, indicating the extent to which an institution's publications are published in journals present in the top 10% most-cited percentiles (by SciVal's CiteScore).
- *Governance interviews*: In order to gather information on the internal and external governance of the three CRPs, interviews were carried out with representatives from the CRPs' government commissioners, boards of directors and executive management. The interview partners are listed in Appendix A 2.
- *Benchmark analysis*: Finally, a benchmark analysis was carried out to assess selected aspects of the CRPs compared to international research and technology organisations. The benchmark analysis aimed to compare governance structures. Furthermore, information about the institute's strategy and performance was collected. Based on the results of the benchmark analysis, the evaluation team draws conclusions on the institute's governance. Where possible additional conclusions as regards strategic positioning and performance of the institute were drawn. The benchmark analysis was based on document analyses and interviews with representatives of the benchmark institute. The benchmark institute was selected based on a pragmatic approach: the evaluation team selected institutes of comparable size and similar thematic orientation. Moreover, a benchmark institute with whom the evaluation team had previous contacts and access was chosen. Nevertheless, the comparison focused on selected aspects, especially governance, and does not provide a detailed analysis of all core aspects of the institute. For LIST, the Centre Suisse d'Électronique et de Microtechnique (CSEM) was chosen as a benchmark institute.

### 1.1.3 Report structure

This institute report summarises the overall results of the evaluation of LIST. The report is divided into four parts. Chapter 2 presents a synthesis of the results at the departmental

level. Chapter 3 presents the results as regards the external and internal governance at institute level. Chapter 4 describes the results of the benchmark analysis. Finally, the report concludes with the overall assessment and recommendations for the institute (see chapter 5).

## 1.2 Description of the institute

LIST was established in 2015 through the merger of the Lippmann and the Tudor in 2015. LIST's mission is to carry out fundamental and applied research activities oriented to the needs and interests of public or private socio-economic actors at the national and international levels in relation to technology development. The institute is organised as four departments: the Department of Materials research and Technology (MRT), the Department of Environmental Research and Innovation (ERIN), the Department of IT for Innovative Services (ITIS) and, since 2020, the European Space Resources Innovation Centre (ESRIC).

### I Vision and mission

The vision of LIST is to be a reference point for research and innovation for a digitalised, resilient, and sustainable society. The institute, therefore, takes on a bridging role between fundamental and applied science and industry as well as the public sector. As defined in the CRP law, LIST has the specific task of carrying out innovation and scientific research activities oriented to the needs and interests of public or private socio-economic actors. An essential part of LIST's mission is Knowledge and Technology Transfer; translating the results of the institute's research activities into useful and sustainable innovations for the economy, society, and the international scientific community. LIST, therefore, aims to assist its public sector partners in their missions and supports the competitiveness of the private sector (CRP law, Art. 30).

### I External governance structures

The government funding (block grant) and activities of LIST are defined in the four-year performance agreements between the MESR and LIST. The agreement also defines elements such as reporting and evaluations. The objectives are specified through performance indicators, e.g. for external funding, scientific publications, dissertations and completed doctoral supervisions at the University of Luxembourg as well as other universities.

The size of the block grant depends on the overall government budget allocated to the funding of public research and the CRPs, the quality of the CRP's strategic plan, its expected social return and alignment with national priorities and the performance of the institute over the previous four-year period. In addition to the block grant, the performance agreement defines a financial institutional bonus linked to the institute's performance and success in the EU Framework Programmes for Research and Innovation. The bonus should go directly to the departments and the research groups taking part in the research activities.

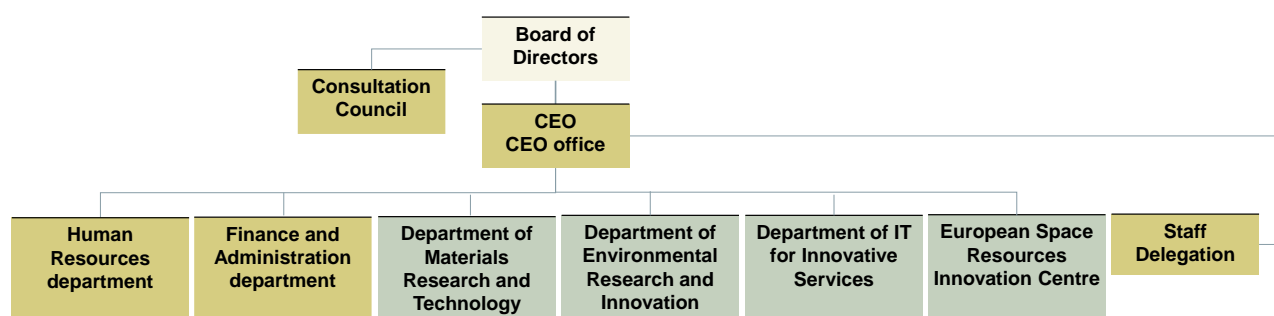
### I Internal governance structures

According to the CRP law, each CRP is to have the following bodies: a Board of Directors consisting of representatives of civil society and the research community who are nominated by the government for a (once renewable) mandate of five years, a Chief Executive Officer (CEO) appointed by a recruitment committee following a recruitment procedure, a Staff Delegation elected on a five-year basis by staff members, and a Consultation Council consisting of six representative staff members elected on a five-year basis by staff members and of two representative staff members appointed by the Staff Delegation for a five-year mandate. The CRP law further stipulates that the activities of

the institutes are to be structured into departments representing related disciplines defined by the Board of Directors. The departments may be supplemented by technological platforms to pool the institute's resources. In addition, the CRPs may set up support services for research, development and innovation, administrative and technical support services.

The management of LIST is organised into an Executive Committee, consisting of the CEO and the directors of the four departments: the Department of Materials Research and Technology (MRT), the Department for Environmental Research and Innovation (ERIN), the IT for Innovative Services Department (ITIS) and the European Space Resources Innovation Centre (ESRIC) as well as the directors of the Human Resources department and the Finance and Administration department. The main bodies of LIST are presented in graphic D 1.1.

**D 1.1: Main bodies of LIST**



Source: LIST self-Assessment Report.

LIST staff are supported by a number of research management and support infrastructures at institute level, including the CEO Office which includes central services such as legal services, communication services and the Transfer and Technology Office (TTO). There are plans for a joint Technology Transfer Office (TTO) between LIH and LIST to manage knowledge and transfer activities of both institutes including business coordination and European affairs, creating spin-offs, IP management, market intelligence, outreach and vocational training. However, the TTO was not implemented during the evaluation period due to difficulties encountered in the recruitment of a head.

Additional support is provided by the Human Resources department which comprises the Business Partners unit, the Talent Acquisition and HR Administration Service Centre of Expertise, the Learning & Development Centre, a Diversity and Inclusion Officer and a HR projects unit, and the Finance and Administration department which includes the Accounting Office and a Cash Management Office, an Information Security Office, a Risk and Compliance Office, a Quality Management Office, a Finance unit, an IS Application and Development Unit, a Performance Management Unit and the Operations Unit.

Finally, the institute has established three collegial committees; the Research Ethics Committee (responsible for ethics reviews of project proposals and ongoing projects) and the Health, Safety and Environment (HSE) committee.

#### **I Financial and human resources**

LIST's funding comes from two sources: direct government funding through the MESR (block grant) and externally raised funding (mainly international and national competitive grants, contract research and services). For the period from 2018 to 2021, LIST received a block grant of approximately 193 million euros. In the same period, LIST raised around



111 million euros in external funding. This means that the block grant accounted for around 64 per cent of the institute's total funding in the evaluation period. In 2021, at the end of the evaluation period, LIST employed a total of 662 staff members (FTE 632.52). 51 per cent of the research and technology staff members had a permanent contract. If we include the technical expertise staff, the administrative staff and the research support staff a total of 70 per cent of the staff had a permanent contract.

## 2. Input, output and outcome/impact at department level

In this chapter, we present a synthesis of the results from the peer-reviews in the four departments of LIST. The peer-review results are complemented by the results of the bibliometric analysis.

### 2.1 Input

#### 2.1.1 Strategy

The experts evaluate the strategies of the departments as mostly coherent and comprehensible. With regards to the departments, the experts conclude that MRT's research and market strategy has been continuously implemented and the expert team mainly focused their recommendations on the strategic importance of a further development of the relationship between MRT and the University of Luxembourg. For ERIN, the experts concluded that, even though the department's overall strategy is coherent with the resources and infrastructure available, the department needs to achieve a critical mass in certain focus areas. In addition to the policy support activities provided by the department which were assessed as good by the experts, ERIN needs to develop and implement a market strategy to enhance its impact with industry. As for ESRIC, which only began its research activities in 2021 and therefore has only partially implemented and formulated its strategy, the experts concluded that the department needs to invest in implementing and sharpening its departmental strategy during the next evaluation period, especially as the markets ESRIC is potentially targeting are not in existence yet.

ITIS's strategy and its implementation were rather critically assessed by the experts. ITIS experienced several reorganisations during the evaluation period which went hand in hand with adjustments to the department's overall strategy. The experts, however, observed a consolidation of the department's strategy and reorganisation by 2021 with the arrival of the new director of ITIS. Nevertheless, in the expert's opinion, a revision of the department's strategy with a particular emphasis on the organisational structure, human resources and IP management is necessary.

In three of the four departmental peer-reviews, the experts concluded that the departments, and more generally LIST, would profit from an external Science and Innovation Advisory Board positioned at department or institute level. An external advisory body would be established to a) support the revision of the implementation of the departmental strategy (ITIS), b) complement the strategy process and transition (ERIN) and c) discuss strategic decisions with external stakeholders (MRT). As recommended in the last evaluation, the establishment of an external advisory board is seen as beneficial and this idea is supported by the Board of Directors as well as the Executive Management of LIST.

Overall, the vision and mission of LIST are supported by the departments. The departments have different focus areas which support this vision and mission. However, to reach LIST's overall objectives in economy, policy decision-making and society a further boost to the implementation and development of departmental research and market strategies is needed. As for the implementation of LIST's 2.0 model, with the exception of MRT, the departments are at the very beginning of the process.

### 2.1.2 Human and financial resources, infrastructure and equipment

In all four departmental peer reviews, the experts observed that the departments enjoy highly motivated staff and good working conditions.

During the peer reviews, the expert teams for MRT, ERIN, and ITIS noted that talent attraction, especially the attraction of PhD students, is a challenge, with the pool of available students at the UL being relatively small. In the peer reviews, the experts suggested different measures to attract PhD students, such as cooperation with foreign universities to gain access to a higher number of qualified students.

The experts in the peer reviews concluded that formal career management for young researchers and PhD students within LIST is insufficient. The Executive Management is aware of this because this problem was not only highlighted by the expert teams, but also in an internal employee survey.

In the peer reviews, the experts discussed the ratios of permanent and non-permanent scientific personnel at MRT, ERIN, and ITIS. While the experts acknowledged that an RTO needs a certain number of permanent staff in order to maintain relationships with partners (especially with industry partners), they concluded that MRT and ITIS should carefully assess the balance between temporary and permanent contracts. In both peer reviews, the experts expressed concerns about the lack of flexibility in allocating staff, and the limited possibilities for recruiting the staff needed for new projects or to cover new requirements for scientific competencies.

The Executive Management's "rule of thumb" is a 70 per cent permanent to 30 per cent non-permanent staff ratio. As this has been achieved, the LIST representatives are satisfied. However, ITIS is a concern for the LIST representatives since the department has the highest number of permanent research and technology staff, at 73 per cent of permanent positions. In contrast, MRT and ERIN only have 39 and 53 per cent permanent positions respectively. The high number of permanent staff at ITIS can be traced back to the merger period.

The experts also observed a lack of female staff in all departments, especially in management positions. The expert teams for MRT, ERIN, and ITIS consider this a shortcoming, especially considering that they could identify a clear diversity strategy to account for this issue in all departments.

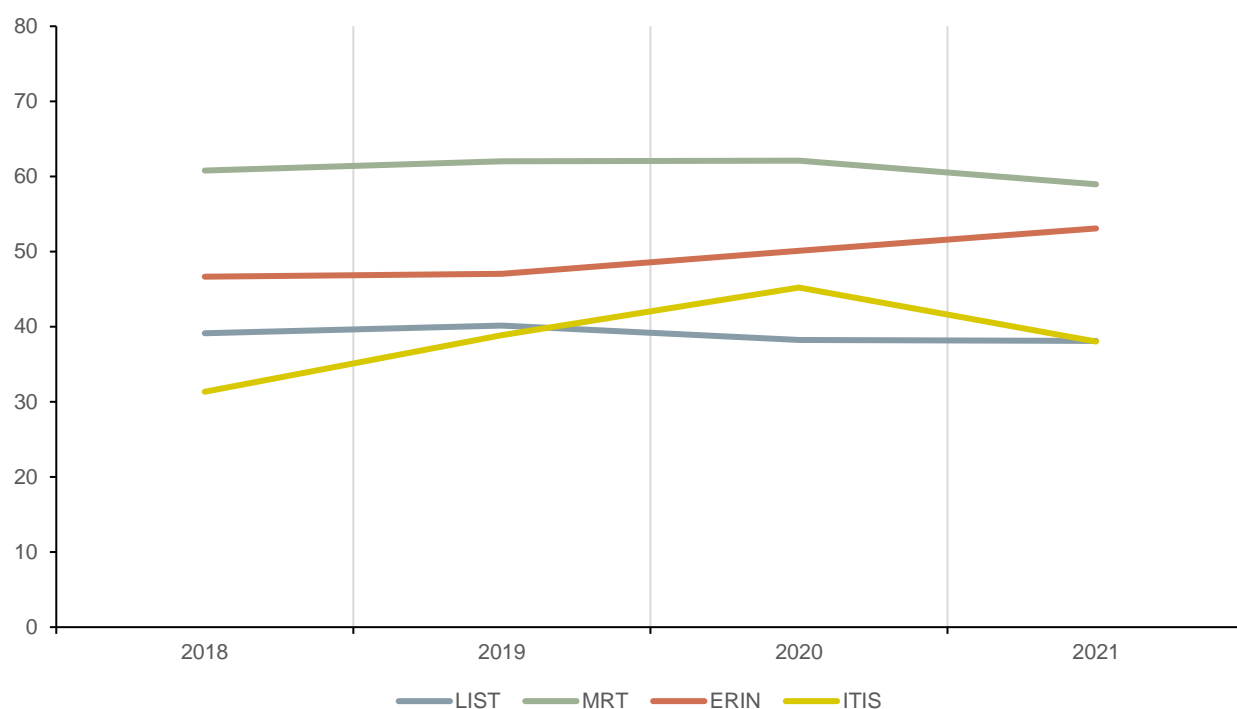
The expert teams rated the overall financial resources of MRT, ERIN, and ESRIC as solid. LIST is mainly financed by direct government funding through the MESR (block grant) and third-party funding (international and national competitive grants and contract research). In 2021, the block grant accounted for around 64 per cent of LIST's budget. During the evaluation period, LIST's block grant steadily increased. The same applied for the competitive and third-party funding of the institute. The a posteriori distribution of the block grant was discussed in all departmental peer reviews (except for ESRIC). The experts agreed that revising the distribution principle is advisable, allowing for ex-ante budget planning by the departments.

The third-party funding varies between the departments. The financial data presented in the self-assessment reports show that MRT is most successful in acquiring third-party funding, with a notable increase in competitive funds granted by the FNR and European programs such as Horizon 2020, as well as collaborative financing provided by the private sector. ERIN's financial performance is assessed positively as well, with the department acquiring an increasing amount of funds from the FNR and European programs as well as

having a vital source of funding in public utility missions in Luxembourg. In contrast, after peaking in 2020, ITIS' competitive funding decreased sharply in 2021. Over the entire evaluation period, the competitive funds have increased slightly. Nonetheless, collaborative funding from the public and private sectors increased during the evaluation period.

As shown in graph D 2.1, third-party funding as a share of the institute's total expenditure stagnates at an average of 40 per cent during the evaluation period. However, it is essential to note that MRT's and ERIN's shares of third-party funds are much higher than that.

**D 2.1: Total third-party finances (% of total expenditures) of LIST**



Source: Self-assessment reports of LIST and its departments (excluding ESRIC).

The high overhead costs originating from both departmental and, in particular, corporate administrative levels were rated as problematic by the experts for the three established departments MRT, ERIN and ITIS. The experts identified the high overhead costs as a challenge to the competitiveness of LIST and they advise LIST to review the cost-benefit ratio of administrative and support services.

During the departmental peer-reviews, the experts rated the infrastructure and equipment available at LIST very positively. The experts see LIST's infrastructure and equipment as an important selling point. Nevertheless, the building infrastructure development raised concerns for the MRT and ERIN expert teams. According to the experts, the predicted lack of available buildings and space poses a threat to the growth plans of MRT and ERIN.

### 2.1.3 Organisation

The experts concluded that LIST's departments are mostly well-organised with structures and processes that support the research and technology development carried out at the research units and research groups. During the evaluation period LIST introduced three new strategic elements affecting the organisation of all departments:

1. A *common organisational blueprint* for the LIST departments, adding support structures for the research units. With the organisational blueprints, LIST aims to streamline the organisation of the departments to align them with the LIST 2.0 strategy. In order to make LIST a fully functioning RTO, a Science, Technology & Partnership Office is established for each department with a Technology Line Management Office and Scientific Expert Fellows.
2. Overarching *Innovation Lines* in each department. The Innovation Lines represent the thematic areas on which LIST concentrates and coordinate the development of several core technologies.
3. (Shared) *Innovation Centres* in the departments. The Innovation Centres are intra-departmental or inter-departmental organisational structures which aim to combine expertise in order to carry out transversal programs and collaborative projects for specific target markets and identify market topics. According to LIST representatives, the Innovation Centres aim to bring technologies developed within the RDI department to demonstrator level.

The implementation of LIST's organizational blueprint progressed during the evaluation period but was not complete in 2021. All departments are in the process of implementing the Innovation Lines. While MRT implemented its Innovation Lines (including the underlying Core Technologies) at the end of 2021, ITIS implemented three of six Innovation Lines at the beginning of 2022, which the department will use as pilots before implementing all the six Innovation Lines identified. In ERIN, three Innovation lines have been implemented in December 2021. They therefore did not show impact at the time of the evaluation. In addition, the implementation of three Innovation Centres started in the evaluation period. LIST aims to have three fully operating Innovation Centres by 2025.

Overall, the experts had difficulties understanding the complex matrix structure established in the LIST organisation blueprint. In general, the organisational structure implemented by LIST is seen as demanding for the staff. The following specific problems concerning the organisation were observed during the evaluation process:

- As regards the organisational charts of MRT and ERIN, the experts did not observe any fundamental changes. However, in ITIS, several organisational changes were carried out: Several changes in the department's management led to change fatigue and strategical and structural uncertainty within the department. The experts conclude that ITIS's organisation had stabilised by the end of the evaluation period. Nevertheless, ITIS is advised to align its strategy and organisational structure further.
- Coordination problems between the various support structures are identified in all departments. Within MRT, the experts observe that internal cooperation between research groups should be improved. Furthermore, the collaboration between the research units and the platforms in MRT and ITIS is limited.
- As for ERIN, comprehension problems between the research units and the support structures are identified. The experts conclude that the role of the Partnership Development Office at ERIN needs to be clarified as regards a) exchanges between the Partnership Development Office and research staff and b) the Communications Officer and the Partnership Development Office.

#### **2.1.4 External research and industry collaboration and service provision**

The expert teams observed a high level of cooperation with the private and public sectors in the three established LIST departments, creating a sound basis for the institute's overall impact on the economy, public administration, and society. While the experts rate MRT's collaborations with the private sector in Luxembourg and ERIN's collaboration with the

public sector very positively, they concluded that ITIS and ERIN should pursue more collaborative projects with industry to increase their impact on the economy.

The third-party funding of the three departments varies as follows: 60 per cent for MRT, 50 per cent for ERIN, and 40 per cent for ITIS. While ERIN's focus on collaborations with the public sector is assessed positively, the experts are of the opinion that the department should enhance its efforts to acquire a) collaborative projects with industry and b) EU projects. As for ITIS, the existing collaborations of the department were assessed positively during the departmental peer-review. However, the experts concluded that the overall third-party funding of ITIS needs to be increased. For MRT, the experts specifically advise the department to introduce a formal debriefing process to systematically assess the satisfaction of the partners. Furthermore, they express concern about the explicit definition of TRL-levels in describing the LIST partnership models for collaborative projects and strategic partnerships. According to the experts, this explicit definition of TRL-levels could unnecessarily constrain future collaborations at MRT.

Considering the external research collaborations of the departments, the expert teams of MRT, ERIN and ITIS concluded that the relationship with the University of Luxembourg is crucial for the positioning and strategic development of LIST. Consequently, the experts conclude that the departments and LIST should seek a strategic alignment and complementary research activities with the UL. The experts for ERIN and ITIS intensively discussed the departments positioning as compared to the Interdisciplinary Centres of the UL, pointing out that the research and innovation landscape in Luxembourg is too small to duplicate activities. Thus, a stronger cooperation through more affiliated positions, joint research groups and an overall strategic partnership is advisable.

## 2.2 Output

### 2.2.1 Quality of output

In the departmental peer reviews, the experts conclude that all three departments produce scientific research of good up to excellent quality (MRT and ERIN). This assessment does not include ESRIC since the department did not produce research and innovation outputs during the evaluation period. Looking at the departments, there are differences as regards the quality of their outputs:

- The MRT experts rated the quality of the department as excellent. Nevertheless, they advise MRT to carefully monitor the quality of its publications as the bibliometric analysis for the department indicates that a higher number of publications of lower quality have been published.
- For ERIN, the experts emphasise that the quality of research output is excellent. In general, the results of the bibliometric analysis show that ERIN is the strongest department in terms of research and impact metrics.
- ITIS's research output is assessed as sufficient by the experts, especially as regards the department's reorganisation and change process. However, they identified differences between the research areas.

The experts conclude that all LIST departments demonstrate contract research and services of very good quality, with overall high satisfaction among the departments' partners in industry and public administrations. The third-party funding was used as an indicator of the quality and quantity of the peer reviews. For MRT, the experts note that the 60 per cent share of third-party funding is excellent. In the peer review of ERIN, the experts stated that the department should increase its third-party funding and concentrate on EU projects and commissioned research by industry. To support ERIN's approach, the experts advise the department to develop a market strategy. In the ITIS peer review, the

experts conclude that to increase the third-party funding above 40 per cent and simultaneously strengthen the impact on industry and the academic world, the department must narrow its focus and concentrate on reaching scientific excellence in a few selected research areas.

The bibliometric analysis shows that LIST is engaged in broad interdisciplinary research, ranging from computer science to mathematics, physics, engineering, and environmental science. Between 2018 and 2021, LIST has increased its annual number of publications, with a total of 1,456 publications. The number of publications in the evaluation period is substantially higher compared to the two other CRPs. The research output impact indicators of the bibliometric analysis (field-weighted citation impact, top citation percentile) show that LIST had a good performance overall, above the research field average in the evaluation period, with an average field-weighted citation impact of 1.27. Publications by LIST received on average 27 per cent more citations than other publications in their corresponding field of research. This indicates an overall good performance.

The data provided in the bibliometric analysis confirms the result of the peer reviews: All LIST departments produced research with average or above-average citation impact and focused on publications in high-quality journals during the evaluation period (see table D 2.2). As regards the performance of the departments, the following observations can be made:

- ERIN, in particular, constantly produced high-quality scientific output during the evaluation period. ERIN's publications received 44 per cent more citations than the average publication in the research field. The Field Weighted Citation Index stayed constant during the evaluation period.
- The bibliometric analyses show that MRT's FWCI is good but decreased during the evaluation period, indicating a lower quality of publications.
- ITIS falls behind the other two departments and is performing at only slightly above the field average.
- ITIS's research output is assessed as sufficient by the experts, especially taking into account the department's reorganisation and change process. However, they identified differences between the research areas.

**D 2.2: Cross-departmental comparison of main quality research performance indicators, 2018–2021**

|                                | <i>MRT</i> | <i>ERIN</i> | <i>ITIS</i> |
|--------------------------------|------------|-------------|-------------|
| Field-Weighted Citation impact | 1.17       | 1.44        | 1.02        |
| Outputs in Top 10% Citations   | 10.5%      | 15.1%       | 13.6%       |
| Output in Top 10% Journals     | 50.5%      | 44.6%       | 24.2%       |

Source: Bibliometric analysis for LIST. \* Number of citations received by publications, divided by average within the same Scopus Subject field. Values >1 indicate above average within field citations, values <1 indicate below average.

Considering the quality of the innovation outputs of the LIST departments, the experts encourage all departments to conduct a careful cost-benefit analysis of their IP portfolios. While the experts were mostly satisfied with the number of patents granted, they concluded that the revenues generated through licenses are sometimes disproportionate to the cost of holding the patents. Thus, they advise LIST's departments to review their IP portfolios but they acknowledge that the patents granted also enhance the visibility of the departments' innovation outputs.

### 2.2.2 Quantity of output

The experts conclude that MRT's and ERIN's research and innovation outputs are of good quantity. The research and innovation output of ITIS is sufficient, given the reorganisational processes and resources in the department. The expert group for ITIS also concludes, that there is a concentration of high quantity of publications with just a few researchers. This imbalance within the department should be reviewed.

The self-assessment reports show that the number of peer-reviewed publications of MRT increased, while the number decreased for ERIN (while staying at a high level) and ITIS between 2018 and 2021. The same holds true for the publication intensity per researcher which increased for MRT but decreased for the other two departments. Overall, ERIN demonstrates the highest volume of research output both in absolute and relative terms. The lowest volume is demonstrated by the ITIS department.

**D 2.3: Cross-departmental comparison of quantity of research performance indicators, 2018–2021**

|  | <i>MRT</i> | <i>ERIN</i> | <i>ITIS</i> |
|--|------------|-------------|-------------|
| Number of peer-reviewed publications   | 487        | 767         | 290         |
| Annual average number of peer-reviewed journal publications  | 119.5      | 191.8       | 72.5        |
| Annual average number of refereed journal publications per FTE research personnel (Publication intensity per researcher) | 0.90       | 1.3         | 0.85        |

Source: Bibliometric analysis for LIST and self-assessment reports of departments. \* Excluding ESRIC which has not yet produced research and innovation outputs during the evaluation period.

All departments have the potential to improve the quantity of their innovation output. The number of patents granted and licences is generally sufficient. Out of the three departments, MRT submitted, and was granted, the highest number of patents between 2018 and 2021. The experts conclude that the innovation output as regards patents and licences for MRT is appropriate. In the peer review for ERIN and ITIS, the experts state that the quantity of patents and licences is only partially appropriate. The experts mention in particular, that ERIN's output volume could be improved through a higher number of larger industry collaborations.<sup>2</sup>

The number of start-ups and spin-offs created by the LIST departments fulfils the KPI set in the performance contract. However, for MRT, the experts concluded that there is potential for a higher number of spin-offs to be created given the size and resources of the department. Fostering an entrepreneurial spirit within MRT is seen as necessary to creating more spin-offs in the future. ERIN and ITIS each created two spin-offs during the evaluation period. This was rated as good by the experts. Overall, the experts concluded that efforts to create spin-offs should be intensified. This could be supported by the

<sup>2</sup> When assessing the number of patents granted, the time span between the submission and acceptance of patent applications must be considered. The acceptance period for submitted patents often extends beyond the evaluation period. Several patents submitted may be granted during the next evaluation period. However, the evaluation cannot make an assessment about the expected success rate. Nevertheless, the submitted patent applications give an impression of the performance of the departments during the evaluation period.



implementation of the spin-off policy at LIST level, which by the time of the evaluation existed as a draft.

**D 2.4: Cross-departmental comparison of quantity of innovation performance indicators, 2018–2021**

|                                   | <i>MRT</i> | <i>ERIN</i> | <i>ITIS</i> |
|-----------------------------------|------------|-------------|-------------|
| Patents submitted (OLB/OAB/OEB)   | 60         | 18          | 21          |
| Patents granted (EPO, USPTO, JPO) | 63         | 14          | 8           |
| Paying licenses                   | 6          | 8           | 54          |
| Spin-Offs                         | 1          | 2           | 2           |

Source: Bibliometric analysis for LIST and self-assessment reports of departments. \* Excluding ESRIC which has not produced innovation outputs during the evaluation period.

### 2.3 Outcome and impact

In all three departmental peer-reviews, the experts conclude that LIST departments have an economic impact or an impact on the public administration. There are visible differences between the departments; whereas ERIN and ITIS provide extensive contract research and services to the public administration in Luxembourg, MRT focuses on contract research and technology development for industry. In general, all expert teams observed that the LIST departments are valuable partners for their stakeholders from national authorities and the industry.

The experts conclude that the economic impact MRT and ERIN provide through knowledge and technology transfer to the private and public sector in Luxembourg is high. For MRT, the experts conclude that cooperation with the private sector is excellent. The long-standing collaborations with industrial partners at MRT have a positive impact. According to the experts, ERIN generates an impact by providing contract research for the public administration. Highlighted examples showing the impacts of MRT and ERIN in the departmental peer reviews are MRT's partnership with Goodyear and ERIN's wastewater monitoring of SARS-CoV-2 or the creation of the WASDI spin-off. ERIN's economic impact on industry is seen as limited by the experts because of the low number of industry collaborations. The experts in the ITIS peer review note that its impact on industry could be increased. Both ERIN and ITIS are encouraged to concentrate on increasing their economic impact. ITIS is also advised to clarify the department's strategy as regards its impact goals.

According to the results of the departmental peer-reviews, MRT and especially ERIN have good academic impacts. The experts in the ITIS peer review note that the department does not seem to have a high academic impact. The experts in ERIN's peer review additionally assessed the department's environmental impact stating that the department has a positive direct and indirect impact provided through the department's environmental monitoring services and integrated environmental assessments.

The experts for ITIS and ERIN conclude that the international visibility of both departments could be improved.

## 3. External and internal governance at institute level

In this chapter, we present the findings regarding LIST's external and internal governance. The results are based on the interviews with representatives of the Government Commissioner, the Board of Directors and the Executive Management of LIST and are supplemented with information from the self-assessment reports and peer reviews of the four departments.

### 3.1 External governance

The law on the organisation of public research centres<sup>3</sup> constitutes the objectives, general mission, and organisation of CRP LIST. It further regulates the staff, intellectual property and relations with the government including the multi-annual planning, financing and cooperations. Based on the CRP-law, the MESR and LIST negotiate a four-year performance agreement, which stipulates the CRP's strategy, budget and the key performance indicators. An evaluation of the performance agreement and its main elements can be found in the next paragraphs.

#### 3.1.1 Performance Agreement

The four-year performance agreement between CRP LIST and the MESR is the main instrument of external governance. The performance agreement is negotiated between the MESR and the executive committee of LIST. It includes the following main elements:

- strategy
- financing through the government-provided block grant
- Key Performance Indicators (KPIs) for the CRP

The basis for the performance agreement is the Multi-Annual Planning and the Multi-Annual Financial Planning written by LIST's Executive Committee (ExCom). The Board of Directors (BoD) must approve the MAP. The MAP is a strategy implementation program and an action plan continuously revised throughout the evaluation period. According to the partners involved, the negotiation of the performance agreement is based on a continuous negotiation and exchange process with the MESR.

The performance agreement is positively evaluated by all actors involved. For the Board of Directors, the performance agreement provides a pre-visibility of LIST's financing. For the Executive management, the performance agreement provides enough flexibility to adjust the overall strategy during the evaluation period. In general, the BoD and the Executive Committee see the performance agreement and the negotiations with the MESR as a useful tool to define a clear framework for the institute's development and activities. For the MESR, the performance agreement is the main steering instrument.

The performance agreement is the main steering instrument for the MESR. Nevertheless, for the MESR, the steering possibilities provided by the performance agreement are limited. Theoretically, the MESR could steer the institute over the budget (e.g. the block grant) and the key performance indicators. However, the steering provided by the ministry is impeded because the MESR is not involved in the decision on the budget for the CRPs,

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<sup>3</sup> Loi du 3 décembre 2014, Organisation des centres de recherche publics.

and the distribution of the block grant for the CRPs is not executed based on a performance-based approach (except for the EU-Bonus). Additionally, the key performance indicators are seen as not ambitious enough. We will elaborate on these two points in the next two paragraphs.

### I Performance Indicators

The KPIs can be divided into two groups: the first group includes KPIs that measure the academic performance of the institute and the second includes KPIs that measure the Institute's innovation performance. During the evaluation period, the additional KPIs for LIST were negotiated between the MESR and the Executive Committee. The KPIs for the 2022 to 2025 period included demonstrators as performance measurements.

LIST proposed additional pilot KPIs including, among others, transfer and valorisation indicators to account for third-party funding and service revenues. However, they were not included in the performance agreement for the 2022-2025 period. According to the LIST representatives, the new KPIs better account for LIST's RTO mission even though they do not fully cover the institute's mission. In the peer reviews, the experts supported this assessment and recommend a revision.

The KPIs defined outline a clear performance expectation and ensure the strategic orientation of the CRP towards scientific and applied research. However, in most cases, the indicators were fulfilled by the institute. This observation leads to the assumption that the KPIs need to be more ambitious in order for them to be an effective steering instrument. Despite this finding, the KPIs are important for information purposes and the legitimisation of the activities of the CRP.

### I Budget

In the performance agreement for the period from 2018 to 2021, the total block grant was set at around 188 million euros. In fact, the actual block grant was higher and amounted to around 193 million euros according to the self-assessment report. This is because of a renegotiation based on the new strategy and reorganisation in 2019/20. The block grant accounts for around 64 per cent of LIST's total funding in 2021, with the remaining 34 per cent originating from third-party funding.

All parties consider the available budget for the institute's activities to be adequate. The use of the block grant is determined in a yearly budget process. The block grant is not earmarked and LIST therefore has a lot of flexibility in its allocation. The Finance and Audit Committee of the BoD links the budgetary process to the strategy and mission of LIST. In addition to the block grant, MESR distributes a bonus based on the CRPs' success in acquiring EU projects.

With the determination and distribution of the block grant not being performance based, the MESR's steering role is limited. Only a small portion of the block grant, the 'bonus institutionnel', which is an incentive-based bonus awarded for success in the acquisition of EU-projects, allows for effective steering but it is relatively small compared to the total amount of block grant distributed.

Parliament decides on the budget for the CRPs and makes its decision based on the preceding budgets. Consequently, the MESR is not involved in the decision on the budget for the CRPs and the distribution of the block grant for the CRPs is not executed in a performance-based approach.

### I Strategy

The strategy is individually embedded in the performance agreement. The institute's strategy stipulates the following strategic principles: LIST's mission is to conduct research for high-impact innovation on behalf of the industry and national public authorities. The strategy of LIST as an RTO is to align its research, development and innovation (RDI) activities with the socio-economic and industrial growth of Luxembourg. LIST's mandate is to act as a bridge between research and industry and to transfer knowledge and technology to the industry and decision-makers in the public administration in Luxembourg. In order to fulfil its bridging role LIST must on the one hand provide research excellence, and on the other cooperate with public and private institutions in order to transfer knowledge and technology to stakeholders. As is clearly stated in the performance agreement, this balance between fundamental and applied research as well as technology development needs to be maintained.

Based on the interviews and the results of the peer reviews, the evaluation team assessed the implementation of the strategy. During the past four years, the institute was mainly able to maintain a balance between fundamental and applied research. LIST and the MESR see it as essential to maintain this balance. The results of the interviews indicate that the strategic elements are well embedded in the performance agreement. In the next evaluation period, the strategy could, however, be elaborated in more detail in the Performance Contract. In order to further expand research and technology development in the long term, LIST is expected to enhance its focus on research in order to maintain its position between research and industry in the future. The role LIST plays for the local industry is important. It is pointed out that the material research performed by LIST kept important industrial players in Luxembourg.

The strategic positioning of LIST as compared to the University of Luxembourg (UL) and especially the UL's Interdisciplinary Centres was an ongoing point of discussion in the departmental peer-reviews but also in the interviews with the different parties involved in the governance of LIST. While LIST's positioning is complementary to the University of Luxembourg in the fields of material science and environmental sciences, in other areas a lack of coordination and cooperation is observed between ITIS and the Interdisciplinary Centre of Science and Technology (SnT). Furthermore, it is foreseen that there will be thematic overlaps between ERIN and the Interdisciplinary Centre on Complex Environmental Systems. With both ITIS and ERIN lacking critical mass in certain areas and, in the case of ITIS, scientific excellence, in some of their research activities, the Interdisciplinary Centres of the UL pose a threat to LIST in the future. Even though LIST's representatives seek dialogue with the University of Luxembourg, there has been little progress in better aligning the institutions in the areas mentioned above. The Framework agreement between the UL and LIST implementing joint research groups and fostering joint educational programs and affiliated professorships is important, but seemingly does not provide enough formal strategic dialogue between the institutions. According to the Executive Management and the Board of Directors, different attempts to achieve better coordination have failed. Furthermore, according to the LIST representatives, there is little steering from the MESR.

In the departmental peer-reviews the experts concluded that the departments, and more generally LIST, would profit from an external Science and Innovation Advisory Board. This assessment is supported by LIST's representatives during the governance interviews.

#### 3.1.2 Board of Directors

The Board of Directors determines the general policy, annual budget, strategic decisions and activities of LIST. The explicit strategic responsibility of the board is seen as a suitable

instrument to guarantee the freedom and independence of the strategic orientation of the institute. The partners involved describe the collaboration between the Board of Directors and the Executive Management as good and engaging. According to the partners involved, the yearly budget process and the strategy development, in particular, are characterised by intensive and constructive discussions.

The MESR appoints a Government Commissioner who attends the meetings of the Board of Directors of the CRP in an advisory capacity. According to the MESR, the main task of the Commissioner is to ensure that all the regulations in the CRP law and the performance agreement are fulfilled. To this end, the Commissioner has a right of veto on the Board of Directors (by the end of the evaluation period this had never been used in practice). According to the partners involved, the representation of the MESR on the Board of Directors functions very well. The CEO negotiates the performance agreement directly with the Commissioner. The Board of Directors must then approve the performance agreement and, in case of blocking, in negotiation with the CEO.

### 3.2 Internal governance

#### I Organisation

At the end of the evaluation period the reorganisational process described in section 2.1.3 was still in progress. LIST's representatives are satisfied with the progress made so far. As explained in the governance interviews, the Executive Management is eager to finalise the implementation of the organisational blueprint for all departments in order to gain a clear understanding of the organisational structure of each department. According to LIST's representatives it is agreed that more time is needed to fully implement and stabilise the new organisation. Several positions are still vacant (e.g. Technology Line Managers, Head of Technology Transfer Office). The newly implemented Innovation Centres are seen as testbeds for LIST. The integration of additional Innovation Centres at the institute in the future will be discussed in the coming years.

Within LIST, the reorganisation constitutes a matrix organisation. It is pointed out by LIST's representatives, that the new organisation is not yet fully understood by the staff. This impression is also shared by the experts, who found it challenging to understand the organisational structures within LIST. This lack of understanding of the new structures poses the threat of shadow structures in the departments. In general, the structure is seen as complex, especially considering the Innovation Lines and, in particular, the Innovation Centres which add a transversal element to the organisational chart.

#### I Support structures

The administrative structure at the corporate level has been criticised in the departmental peer-reviews. According to the expert groups, the departments consider the general overhead costs to originate to a large extent from the corporate level, as well considering the full-cost model to be a major restriction for LIST's competitiveness. The efficiency of the support structures was questioned in the peer reviews (see section 2.1.3).

The interviews show that LIST's management is aware of the problem of the imbalance between the costs of the administration and the services provided. But the evaluation has not identified a strategy for LIST's management to address the problem.

#### I Allocation of financial resources

The question of the distribution of the block grant was addressed in the peer reviews and in the 2018 evaluation. Hence, it was also discussed during the interviews with LIST's management. The situation is as follows: within LIST, the allocation procedure for the block grant is an ongoing topic of debate. So far, the block grant is not distributed directly

to the four departments but is considered overall funding for the institute to support a) co- and self-funded projects, b) investments in infrastructure and c) equipment, as well as administration and support structures within the institute. A further increase in the performance dependence of the allocation is currently being discussed by the Executive Committee and the Board of Directors. At the institute level, there are ongoing efforts to install a department-based budget approach making the departments complete business units. The institute plans to base the block grant distribution on performance, strategy, and organisation in the future. This would allow a direct distribution of the block grant to the departments. Additionally, making the departments full business units will allow them to improve their financial planning. Moreover, the departments will be able to channel back the funding received to their support services, making the allocation process more transparent.

### I Infrastructure

LIST's departments were spread over four sites during the evaluation period. According to the LIST representatives, the institute follows a growth strategy and the RDI departments need more space to employ large-scale equipment. A long-term building strategy was implemented to formalise the growth plans. LIST aims to bring together all departments on the Belval campus by 2030. Therefore, project work on three future buildings for LIST's RDI departments started in 2021 (Laboratoires des Ingénieurs for MRT, the Maison de l'Environnement for ERIN, and a building for ESRIC). MRT will move into the Maison des Matériaux in 2023.

LIST's representatives raised concerns regarding the infrastructure situation of the institute. Two concerns were highlighted during the evaluation:

- LIST does not own the buildings the departments are located in. Therefore, the institute has limited flexibility on the use of the buildings.
- Delays are expected in the completion of the buildings for LIST. Furthermore, MRTs move into and equipping of the Maison des Matériaux has been delayed.

According to the Board of Directors and the Executive Committee, LIST's growth could be limited by the delays and the current infrastructure policy.

## 4. Benchmark analysis

In this chapter, we present the results of the benchmark analysis. The analysis is based on document analyses and interviews with representatives of the benchmark institute, interviews with representatives of the Government Commissioner, the Board of Directors, and the Executive Management of LIST, as well as information from the self-assessment report of LIST.

The CSEM was chosen as a benchmark institution for LIST. The selection of the CSEM was based on a) the comparable size and thematic orientation of the institute with LIST and b) the fact that the evaluation team has conducted an evaluation of the CSEM in 2022 and therefore had a deep knowledge and contacts to the institute, which were used to conduct the benchmark analysis. The selection of the benchmark institute is, however, debatable. Nevertheless, with the RTO landscape being very heterogeneous, the evaluation team considers the benchmark institute a suitable case.

The benchmark analysis focused on the governance of the institutes. Furthermore, we took additional aspects regarding organisation and performance into account. Differences between the institute were elaborated on and discussed by the evaluation team. However, the pragmatic approach in comparing the institute does not allow for a detailed, in-depth analysis of the institutions. However, it draws attention to some important aspects that should be considered in the institute's development.

### 4.1 Comparison of strategy and areas of activity

#### I Development

For LIST, the Centre Suisse d'Electronique et de Microtechnique (CSEM) was chosen as the benchmark organisation. The CSEM was formed in 1984 when three microtechnology institutions, the Center of Electronic Horology (CEH), the Swiss Foundation for Research in Microtechnology (FSRM), and the Swiss Laboratory for Watchmaking Research (LSRH), merged to become one centre. Located in Neuchâtel, a region in western Switzerland well known for its watchmaking industry, the CSEM originally concentrated on applied research and technology development in the field of microtechnology, primarily for the watchmaking industry in Western Switzerland.

The CSEM and LIST therefore share a similar development, both RTOs being the product of a merger of different institutions with LIST being created in 2015 from the merger of the CRP Gabriel Lippman and CRP Henri Tudor, both founded in the 1980s. Since 1984, the CSEM has continuously readapted its research focus to meet the needs of Swiss industry, leading the CSEM to expand its fields of activity beyond the use of microtechnology for watchmaking and into the fields of precision manufacturing, digital transformation, and sustainable energy solutions. As an RTO, the CSEM is positioned between research and industry in its fields of activity and, like LIST, concentrates on being a conduit between the two areas.

The CSEM plays a unique role in the Swiss research and innovation landscape and therefore receives a block grant from the Swiss government as well as six cantons. The CSEM's headquarters are in Neuchâtel and it operates five additional autonomous regional centres in the German speaking parts of Switzerland. This regional implantation strategy differentiates the CSEM from LIST, although, like LIST, it is located in a small country with established academic institutions. With Swiss universities and the ETH Domain, and a network of joint competence centres in the fields of material sciences and



technology, environment and sustainability as well as energy and mobility, the CSEM has established close cooperations, and especially with the EPFL, through a formal strategic alliance.

### I Strategic orientation

The mission of the CSEM is to develop technologies and to transfer them, primarily to Swiss industry in order to strengthen its competitive position. LIST's mission is similar, however, some differences in the strategic orientation of the two RTOs can be identified.

The CSEM focuses on applied research and technology development providing contract research and services for the industry. The institute relies on the ETH domain and Swiss universities and builds on the results of the fundamental research conducted. The main focus of the CSEM is knowledge and technology transfer to the industry through collaborative projects and services. This is clearly visible in the centre's funding structure, with 34 per cent of the CSEM's funding originating from collaborative projects with the industry, as opposed to LIST's 14 per cent. Additionally, the CSEM does not provide science-based policy-support which is an important element of LIST's mission. Furthermore, the CSEM does not pursue a specific publication strategy and thus has a much smaller publication output than LIST. This differentiates the CSEM from LIST, which has a stronger focus on fundamental research and applied research. For both institutions, infrastructure and equipment are a main selling point and are of strategic importance.

In terms of international outreach, the CSEM and LIST differ. LIST's strategic objectives include international recognition and outreach due to its strong focus on scientific excellence. The CSEM's mission concentrates on the Swiss research and innovation landscape. Nevertheless, the CSEM actively engages in international projects and is a member of the Heterogenous Technology Alliance (HTA), a network of four European RTOs<sup>4</sup>, in order to support its efforts in European project proposals and thus support the CSEM's international outreach.

### I Research and service areas

The CSEM conducts research and technology development in three main research areas. It focuses on development and application activities in the areas of:

- *Digitalisation* including edge processing, IoT, industry 4.0, quantum technologies, data, and AI, as well as digital health.
- *Precision manufacturing*, including microelectrochemical systems (MEMS) and packaging, additive manufacturing (AM), photonics, functional surfaces, tools for life science, as well as scientific instrumentation.
- *Sustainable energy*, including PV and solar buildings, digital grid, mobile harvesters, as well as storage.

Similarities between the research agendas of LIST and the CSEM can be found in all of the research areas summarised above. With MRT and ITIS covering the areas of precision manufacturing and digitalisation and ERIN's activities partially overlapping the area of sustainable energies. Nevertheless, the fields of activity of the CSEM are narrower than

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<sup>4</sup> Members of the HTA are the Fraunhofer Institutes (Germany), VTT (Finland), CEA LETI (France) and the CSEM. In the Horizon 2020 program around 55 percent of the projects realised or coordinated by the CSEM were conducted with at least one of the HTA-partners (CSEM 2019: Planification 2021-2024. Neuchâtel, p. 30).



the research areas covered at LIST. Furthermore, LIST's activities are more multidisciplinary, including, for example, biotechnologies and environmental analytics, which are not a part of the portfolio of the CSEM. In addition, while the CSEM has expertise in precision mechanism and instrumentation for use in space exploration, space resource exploration and utilisation is not a priority area for the CSEM but LIST is developing a department around this field.

The service areas of the CSEM include, among others, coating services, MEMS and microsystems solutions, optical simulation and modelling tools, and materials characterisation. The facilities available at the CSEM are also used by clients conducting their projects. LIST has established several technology platforms which offer standardised and made-to-measure services in the fields of testing, measurement, analysis, innovation management, methods, and software development. The service areas of the CSEM and LIST follow similar approaches and solutions, with both institutions providing a variety of services and facilities to use.

### I Target groups and partnerships

The main target group of the CSEM is the private sector, including large companies and SMEs. Around 34 per cent of the CSEM's third-party funding stems from collaborative projects with the private sector or service contracts. Since its formation, the CSEM has established close and longstanding cooperations with its clients. The CSEM engages in collaborative projects funded by competitive processes. In total, 25 per cent of third-party funding stems from competitive funds, of which 10 per cent is acquired by Innosuisse, the Swiss Innovation Agency, which mainly funds research projects and collaboration projects with industry partners. LIST has a broader target audience, including the private and public sectors in Luxembourg. LIST, for example, provides policy support to the public administration. It also focuses more on conducting fundamental research than the CSEM and thus addresses the scientific community.

The CSEM has established several partnerships with the ETH domain, universities of applied sciences, cantonal universities, and other research and innovation actors in Switzerland. The CSEM formalised a strategic alliance with the EPFL in 2018. Collaborating with the EPFL is especially important to align research activities in the areas of "Precision Manufacturing" and "Sustainable Energy". Both the EPFL and the CSEM are active in these areas. Hence there is a need for complementarity, with the EPFL providing fundamental research and the CSEM providing applied research and technology development. For that reason, representatives of the ETH domain are members of the Scientific Advisory Board of CSEM.

LIST cooperates with research institutions at national and international levels, such as the University of Luxembourg, other CRPs, and foreign universities. LIST formalised its relationship with the UL through a Framework Agreement in 2020, establishing cooperation through staff linked to both institutions and common research activities. However, according to the LIST representatives, there is an overlap between LIST and the Interdisciplinary Centres of the University of Luxembourg, especially SnT and potentially the newest centre on Complex Environmental Systems.

Regarding international partners, CSEM is involved in the Heterogenous Technology Alliance (HTA), a network of four European RTOs<sup>5</sup>, in order to support its efforts in

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<sup>5</sup> Members of the HTA are the Fraunhofer Institutes (Germany), VTT (Finland), CEA LETI (France) and the CSEM. In the Horizon 2020 program around 55 per cent of the projects realised or

European project proposals. The CSEM cooperates closely with the Fraunhofer Institutes (Germany), VTT (Finland) and CAE Leti (France).

#### I Transfer and Valorisation support structure and IP strategy

The CSEM has a legal and IP service which is responsible for administrative services. Additionally, the business units at CSEM each have their own IP representative, who is in most cases an engineer working on IP and business development. LIST is currently developing a Transfer and Technology Office (TTO) which will manage the institute's intellectual property in the future. Most of the CSEM portfolio originates from background IP (IP that is not developed only by the CSEM without industry partners). The CSEM focuses on background IP to keep the cost of its IP portfolio in balance with the revenues generated. Regarding foreground IP, the CSEM buys licenses from its clients if they are needed to further develop a technology.

As regards IP management, the CSEM conducts a yearly patent portfolio review and discusses opportunities for valorisation and possibilities of revenues through licences. The revenues generated through licences was around 3.7 million CHF in 2021, compared to approximately 1 million CHF of expenditures. LIST's IP policy was validated by the Executive Committee in 2022. Currently LIST is facilitating IP management and adequate IP management tools. In 2021, the revenues generated from IP at LIST amounted to a total of 142,000 euros, a significantly smaller amount than the CSEM.

#### 4.2 Comparison of financial and human resources

With a budget of 83.16 million EUR in 2021, the budget of LIST is smaller than the CSEM's budget of 96.98 million CHF in 2021. The CSEM's activities are funded by three main sources: government contributions provided by the State Secretariat for Education, Research and Innovation (SERI) and the cantons, competitive grants stemming mainly from the Swiss Innovation Agency as well as EU-projects (e.g. Horizon2020/Horizon Europe), and collaborative funding generated through contract research for and with industry partners. The composition of LIST's funding differs from the CSEM funding model. LIST mainly finances its activities through government contributions and competitive funds, a large part of which stems from the Fonds National de la Recherche (FNR), which is the main funding agency for research and innovation in Luxembourg. The revenues that LIST generates by contract research and services are significantly smaller.

In 2021, the CSEM had 552 employees (FTE 498.9), while LIST had 662 employees (FTE 632.52). Both institutions experienced an increase in staff during the last four years. The number of permanent staff remained constant at around 70 per cent for LIST and around 80 per cent for the CSEM. The number of scientific staff with permanent contracts is higher at the CSEM (84% research and technology staff, excluding technical staff technical expertise staff) than at LIST (51 % research and technology staff, excluding technical expertise staff). According to the CSEM's representatives, the high number of scientific personnel is justified by the KTT mission of the CSEM, which includes partnerships with industry stakeholders. This also holds for LIST. In order to successfully build and maintain relationships with industry, a consistency in staff is important and is valued by the partners of the institute. LIST's, focus is also on scientific excellence which

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coordinated by the CSEM were conducted with at least one of the HTA-partners (CSEM 2019: Planification 2021-2024. Neuchâtel, p. 30).

allows for a more flexible staff which can quickly respond to new requirements in research.

#### D 4.1: Financial and human resources (as at 31.12.2021)

|                                      | <i>LIST</i>         | <i>CSEM</i>                    |
|--------------------------------------|---------------------|--------------------------------|
| <b>Financial resources</b>           |                     |                                |
| Government Contribution (Euro / CHF) | 53,150,000 (64 %)   | 39,300,000 (40.5 %)            |
| Competitive Grants (Euro / CHF)      | 13,764,000 (16.5 %) | 24,912,000 (25.7 %)            |
| Contract Research (Euro / CHF)       | 12,226,000 (14.7 %) | 27,850,000 (28.8 %)            |
| Paid Services (Euro / CHF)           | 2,246,000 (2.7 %)   | 4,086,000 <sup>1</sup> (4.2 %) |
| Other (Euro / CHF)                   | 1,774,000 (2.1 %)   | 830,000 (0.8 %)                |
| Total financial resources            | 83,160,000 (100 %)  | 96,977,000 (100%)              |
| <b>Human resources</b>               |                     |                                |
| Staff (FTE)                          | 662 (632.52)        | 552 (498.91)                   |
| Share of permanent contracts         | 69.67 %             | 77.4%                          |

Source: LIST self-assessment report; CSEM Annual report 2021 and internal documents.

Detail: <sup>1</sup>Paid services; services, production.

### 4.3 Comparison of governance

#### 4.3.1 External governance

The external governance of the CSEM is somewhat different. As with LIST, the CSEM is governed by a four-year performance agreement with the government funder. Both agreements specify the research activities and expected results that the institutions must fulfil with the government funds provided. The SERI does not define performance indicators for the CSEM but LIST must achieve a set of quantitative performance indicators set by the MESR. Both institutions report annually to the government funder on their activities. LIST's research and innovation performance is evaluated every four years (additionally there is a mid-term review after two years), whereas for the CSEM no regular evaluations are foreseen. To evaluate the CSEM's performance, the SERI commissioned a one-off external evaluation in 2022.

The government funder is not represented in the governing body in the case of the CSEM. The governing body is composed of representatives of industry, the ETH-domain and the canton and city of Neuchâtel. As for LIST, the CRP law in Luxembourg states that the government funder can appoint an observer to attend the meetings of LIST's governing body. Hence, the MESR is represented on the LIST Board of Directors.

**D 4.2: External Governance: Overview of bodies and instruments**

|   | <i>LIST</i>  | <i>CSEM</i>  |
|---|--|--|
| State funder  | Ministry of Higher Education and Research          | State Secretariat for Education, Research and Innovation                     |
| Contract type   | Four-year performance agreement                    | Four-year performance agreement  |
| Performance indicators in contract                        | Yes  | No   |
| Reporting and evaluation                                  | Annual report<br>External evaluation every 4 years | Annual report<br>External evaluation in 2022, no regular evaluation foreseen |
| Representation of the government funder in governing body | Yes, defined in CRP law (advisory capacity)        | No representation  |

Source: LIST and CSEM performance contracts.

**4.3.2 Internal governance**

The internal governance of LIST and CSEM share similar aspects: both institutions are governed by a strategic board and a management board. In addition to those bodies the CSEM has a Scientific Advisory Board which has an advisory role on scientific matters and is composed of internationally renowned scientists, mainly stemming from the ETH-domain, and industry representatives in the fields of the research activities of the CSEM. The Board of Directors appoints the Scientific Advisory Board (SAB), which is approved by the presidency of EPFL, one of the two Swiss federal institutes of technology and strategic partner of the CSEM. The board is also presided over by a representative of EPFL. As discussed in all the departmental peer-reviews, an advisory body for LIST, composed of, for example, main stakeholders and advisors, would be beneficial for the institute's development and should therefore be created.

In addition, the CSEM has support bodies and an extended research committee, which consists of the CEO, the vice-presidents of the business units, the vice-president of the business development unit and the vice-president in charge of start-ups. LIST has several additional bodies such as a staff delegation, a collaborative council, the joint Technology Transfer Office with LIH that is currently in development.

Where the governance structure of LIST is stipulated in the CRP law, the structure of the CSEM is stipulated in the règlement d'organisation. In contrast to LIST, the governance structure of the CSEM is therefore not stipulated by federal law. Both institutions have developed a multi-annual strategy defining their missions, objectives and activities.

**Internal Governance: Overview of bodies and instruments**

|                 | <i>LIST</i>   | <i>CSEM</i>   |
|-----------------|---|---|
| Governing body  | Board of Directors  | Board of Directors  |
| Management body | Executive Committee   | Executive Board   |
| Consulting body | No consulting body established  | Scientific Advisory Board   |
| Further bodies  | Staff delegation<br>Collaborative Council<br>Technology-Transfer Office (in development)<br>Communications Office<br>Legal Services (including Valorisation and IP Policy Office)<br>Technical advisor (since 2021)<br>Strategy advisor (since 2021)<br>Ethics Committee<br>HSE committee | Research Committee<br>Extended Research Committee<br>Legal and IP Service<br>Chief Technology Officer<br>Chief Security Officer |
| Instruments     | Multi-annual strategy   | Multi-annual strategy   |

Source: LIST self-assessment report; CSEM Interviews and internal documents.

#### 4.4 Comparison of output and impact

##### I Output

The Output of the two institutions differs in content and quantity. In line with its strategy, the CSEM produces significantly less scientific output, e.g. publications, than LIST. A comparison of the number of peer reviewed journal articles shows that the publication output of both institutions decreased during the evaluation period. However, LIST managed to increase its publications by the end of the evaluation period.

At the CSEM, the main outputs are collaborative (research) projects with industry including patents and licences, services, spin-offs, and start-ups. The number of patents and licences of the CSEM and LIST is similar, with the institutions showing comparable average values per full-time employee. This indicates that both institutions follow a comparable IP policy. Considering the KTT to stakeholders, the CSEM offers a much higher number of events to its stakeholders, whereas LIST does not prioritise KTT events. In addition, the decentralised structure provides services and events in the different regions of Switzerland. The CSEM produced two spin-offs between 2018-2021. At LIST, a total of five spin-offs was created by former employees, indicating a slightly higher mobility of researcher at LIST. Regarding the provision of services to customers, LIST generated on average 3 per cent of its total revenue from services, compared to the CSEM's 4 per cent share. With both institutions offering a wide range of infrastructure and equipment, this is an important similarity.

Overall, these outputs correspond to the CSEM's strategic orientation (see section 0). As for LIST, the balance between fundamental and use-inspired research and development is more accentuated. The interviews with representatives of both institutions and the data presented in table D 4.3 support this assessment.

D 4.3: Comparison of Key Output Figures

| Output   | LIST        |             |             |             | CSEM        |             |             |             |
|--|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|
|  | 2018        | 2019        | 2020        | 2021        | 2018        | 2019        | 2020        | 2021        |
| Number of peer reviewed journal articles in journals | 401         | 360         | 376         | 407         | 60          | 54          | 65          | 36          |
| <i>Per FTE (all employees)</i>                       | <i>0.80</i> | <i>0.72</i> | <i>0.75</i> | <i>0.82</i> | <i>0.12</i> | <i>0.11</i> | <i>0.13</i> | <i>0.07</i> |
| Patents granted                                      | 12          | 23          | 22          | 28          | 31          | 29          | 24          | 25          |
| <i>Per FTE (all employees)</i>                       | <i>0.02</i> | <i>0.04</i> | <i>0.03</i> | <i>0.04</i> | <i>0.06</i> | <i>0.06</i> | <i>0.05</i> | <i>0.05</i> |
| Paying licences                                      | 20          | 25          | 11          | 18          | 8           | 9           | 7           | 9           |
| <i>Per FTE (all employees)</i>                       | <i>0.03</i> | <i>0.04</i> | <i>0.02</i> | <i>0.03</i> | <i>0.02</i> | <i>0.02</i> | <i>0.01</i> | <i>0.02</i> |
| KTT events for stakeholders                          | 20          | 18          | 11          | 12          | 56          | 79          | 14          | 64          |
| <i>Per FTE (all employees)</i>                       | <i>0.03</i> | <i>0.03</i> | <i>0.02</i> | <i>0.02</i> | <i>0.11</i> | <i>0.16</i> | <i>0.03</i> | <i>0.13</i> |
| Spin-offs <sup>1</sup>                               | 2           | 1           | 1           | 1           | 1           | 1           | 0           | 0           |

Source: SAR LIST. CSEM. <sup>1</sup> Spin-Offs per FTE were not calculated.

### I Impact

Both institutions have an impact due to knowledge and technology transfers through their collaborative projects and contract research with and for industry. While LIST expanded its impact through collaboration with stakeholders in the government and public administration, the CSEM is focused on industry stakeholders. Nevertheless, LIST in particular is experiencing competition with universities. This is less prominent for the CSEM. Both institutions offer a close geographical proximity to potential customers and partners in industry, with both institutes operating in small countries. In contrast to LIST, the CSEM operates several regional sites in order to enhance its impact. Considering the academic impact of the institutions, LIST shows a higher impact than the CSEM due to its high number of scientific outputs. The comparison of the institutions indicates that while both institutions have an impact in their respective research and innovation ecosystem, LIST offers a broader spectrum of impacts than the CSEM, which concentrates on its economic impact.

### 4.5 Concluding remarks

The benchmark analysis highlights important similarities and differences between LIST and the CSEM. A comparison of the *strategic orientation* of the institutes shows that both institutes are strongly rooted in their respective research and innovation ecosystems. While LIST has a dual mission of conducting fundamental research as well as applied research and technology development, the CSEM concentrates on applied research and technology development. Thus, the CSEM has a narrower mission than LIST and has a strong focus on its national economic impact. This is reflected in the institute's target groups: the CSEM is strongly oriented towards the private sector while LIST's target groups are in the private and public sectors.

In terms of *resources*, the institutions differ: LIST profits from higher governmental funding than the CSEM, with its 64 per cent share of block grant compared to the CSEM's 30 per cent block grant (40 percent if funding received from cantons is included). Thus, the CSEM's funding structure is much more dependent on third-party funding.

Considering the *external governance structure*, the CSEM and LIST share similarities in terms of their respective performance agreements. Both institutions operate based on a four-year performance agreement. However, LIST's performance agreement with the MESR includes performance indicators. In contrast, the SERI has not defined concrete performance measurements for the CSEM. Furthermore, while the government funder is represented in LIST's governing body, the same does not hold true for the CSEM. These differences indicate that the government funder is less involved in the external governance of the CSEM.

The *internal governance* of the institutes is somewhat similar but differs in an important aspect: the CSEM has established a Scientific Advisory Board, which includes its main stakeholders and partners from research and industry.

The CSEM and LIST share similarities regarding *outputs and impacts*. There are also important differences to be noted which can be traced back to the institute's different strategies. While LIST shows scientific and economic impact at national and international levels, the CSEM concentrates on its economic impact. Overall, the CSEM does not prioritise academic impacts but fosters a close partnership with institutions providing fundamental research.

## 5. Overall assessment and recommendations

This chapter presents the overall assessment and the resulting recommendations for LIST. The results are presented in more detail in the previous chapters.

### 5.1 Overall assessment

#### I Input

LIST's departments mostly have clear research strategies that support LIST's mission of achieving scientific, economic, and societal impact through fundamental and applied research as well as technology development in Luxembourg and internationally. The LIST 2.0 model introduced in 2020, led to the (ongoing) implementation of strategic adjustments for the departments, restructuring and defining key thematic areas for each department. As recommended in the 2019 evaluation, LIST enhanced its thematic focus. However, the progress made by the departments in terms of implementing their strategies differs. While MRT and ERIN showed consistency and good progress in implementing their strategies, the process at ITIS and ESRIC is only just beginning. At ITIS, the reason for this is a recent change in management structure, while ESRIC is a new department only began its activities two years ago.

In terms of human resources, LIST's departments are evaluated positively as regards working conditions and infrastructure. Nevertheless, in line with the 2019 evaluation, the potential to improve LIST's formal career management and diversity policy was identified. Additionally, the ratio of permanent to non-permanent staff in two departments was hotly debated. As regards LIST's funding, the institute's performance is assessed positively with some exceptions. LIST's financial resources are sound overall, however its departments' success in acquiring third-party funding differs. LIST has covered around 40 per cent of its expenditures with third-party funding, with some departments (MRT, ERIN) contributing more third-party funding than others. As in the formal evaluation period, we advise LIST to review the distribution principle and transparency of the block grant allocation. Activities are under way but need to be further developed.

LIST's departments have been reorganised based on an organisational blueprint defined by the management during the evaluation period. The reorganisational process introduced a complex matrix structure at departmental level. Several new support functions and structures were defined in order to implement key thematic areas (innovation lines). Overall, the organisational structure seems complex and is not yet fully implemented. LIST is advised to carefully observe the ongoing implementation process to prevent inefficiencies particularly as regards the support structures at both department and institute levels.

LIST has established good collaborations with its stakeholders from the economy, administration, and society. Nevertheless, the positioning of LIST's departments in opposition to the relationship with the University of Luxembourg was discussed during the 2019 evaluation and is still an issue. There is potential for more collaboration and complementarity.

#### I Output

LIST demonstrated a good quality and quantity of research between 2018 and 2021. MRT and ERIN, in particular, performed well as regards research output. All established



departments have produced publications with average or above average field citation impacts. The quality and quantity of innovation outputs are rated as good; however, the evaluation team encourages all LIST departments to further strengthen their transfer activities and innovation output (especially spin-offs).

#### I Outcome and impact

LIST's established departments have a clear economic and societal impact, generated by the quality of their output. The knowledge and technology transfer generated by the department's contract research and services for industry, as well as national authorities and the public administration, are to be noted. However, ERIN and ITIS are advised to focus on developing a greater economic impact by increasing their collaborations with industry. The academic impact of LIST's departments is assessed as good in the cases of MRT and ERIN. Nevertheless, LIST's overall impact on the research community could be improved by a stronger performance from ITIS.

#### I Governance

Overall, the internal and external governance of LIST functions well. The external governance is based on the performance agreement and executed by the MESR and the Board of directors. On the whole, all parties involved positively assess the governance structures and the performance agreement as the main steering instrument. The performance agreements include the strategy of the institute, its financial plan, and performance indicators. Despite the positive remarks, a further review of LIST's performance indicators is advisable, and the institute should review the allocation procedure for the block grant. The 2019 recommendations regarding the KPIs and the block grant are therefore still relevant. The internal governance of LIST functions well. However, LIST is advised to reflect on the complex matrix organisation as well as the cost-benefit ratio of the support structures.

In order to manage the ongoing implementation of strategy and organisation and to address future strategic and other challenges, establishing a Science and Innovation Advisory Board for LIST's departments at the corporate level is seen as beneficial. In the 2019 evaluation results, consideration was given to the creation of an Advisory Board. This should be pursued.

#### I Benchmark

As a benchmark, LIST was compared to the Centre Suisse d'Électronique et de Microtechnique (CSEM) in Switzerland. It was found that the two institutes have similar activities. However, they differ in their strategies on one central point; CSEM focuses on collaboration with companies, while LIST places a stronger emphasis on academic research and provides science-based policy support. Consequently, their outputs are different; CSEM has a very high number of projects with companies and a high share of third-party funding (about 60 per cent). LIST, by comparison, demonstrates more scientific output with a higher base funding of 60 per cent. Taking these strategic differences into account, the performance and impact of the two institutes are comparable and are at a good level.

### 5.2 Recommendations for the institute

Based on the overall assessment and the observations stated in the previous chapters, Interface formulates the following recommendations for LIST:

#### I Recommendation 1: Review implementation and complexity of organisational structures

LIST introduced an organisational blueprint for all RDI departments during the evaluation period. In addition, the institute presented a modified strategy, the LIST 2.0 model, in

2020. Overall, these strategic and organisational adjustments have led to a complex matrix organisation, which is difficult for employees and stakeholders to comprehend.

LIST will continue to implement the strategy in the next evaluation period (2022-2025). Thus, Interface recommends carefully reviewing the organisational processes and structures during the ongoing implementation phase. The review's aims should be to identify overly complex and potentially inefficient structures at an early stage and to try to simplify them.

#### **I Recommendation 2: Evaluate cost-benefit ratio of corporate support structures**

LIST's overhead costs are perceived as too high by the experts. The efficiency of the support structures for the cost and benefits of the departments is unclear. Interface recommends critically evaluating the current cost-benefit ratio of the support structures at the corporate level and taking measures to reduce overhead costs in the short-term. From discussions with the LIST management, we know that there are existing benchmarks between European RTOs. From our point of view, these benchmarks are an appropriate basis for discussing overhead costs.

#### **I Recommendation 3: Enforce the implementation of the diversity strategy**

The evaluation of the four LIST departments showed that the proportion of female collaborators, particularly at the management level, is low. Interface recommends promoting and prioritising the implementation of the LIST-wide "Diversity and Inclusion Charter" with clear objectives for every department and LIST to be evaluated during the next evaluation period.

#### **I Recommendation 4: Review the allocation process for the block grant**

The block grant allocation is an ongoing point of discussion and was hotly debated during the 2022 peer reviews and at the last evaluation in 2018. Interface recommends reviewing the allocation process for the block grant. Currently, the block grant is distributed a posteriori. In order to allow more flexible financial planning of the departments, an ex-ante distribution of the block grant should be considered. The following considerations may be helpful in finding a new allocation principle for the block grant:

- The largest share of the block grant should remain at the corporate level to maintain infrastructure and other support functions.
- A second share of the block grant should be allocated to the departments as a global budget for free use in financing research and technology development activities.
- A third share of the block grant should be used strategically by LIST's management. Thus, a share of the block grant may be distributed based on the performance of the departments.

#### **I Recommendation 5: Reflect on the institute's positioning compared to the UL's Interdisciplinary Research Centres**

Interface recommends emphasising the positioning of LIST compared to the University of Luxembourg. Special emphasis should be put on two aspects:

1. Positioning in comparison to the (new) Interdisciplinary Research Centres of the UL
2. Positioning in comparison to departments of the UL, particularly the Department of Computer Sciences and the Department of Engineering

Overall, Interface strongly recommends that LIST should actively work towards complementarity with the University of Luxembourg.

**Recommendation 6: Establish an External Science and Innovation Advisory Board**

LIST underwent a substantial reorganisation during the evaluation period and implemented strategic adjustments. In the context of the reorganisation, an advisory board has already been discussed within LIST.

Interface recommends continuing this discussion and establishing an External Science and Innovation Advisory Board (SIAB) at LIST in the next two years. Interface proposes an advisory board with ten to twelve members. The SIAB should represent the RDI department's core research areas as well as overall strategy. The advisory board of the benchmark institute could be used as a model for the composition of the SIAB. The CSEM's advisory board includes representatives from the national and international scientific community, as well as stakeholders from industry and the public administration.

**Recommendation 7: Revise Key Performance Indicators (KPIs) for LIST**

To better assess LIST's mission, the governing bodies added two new KPIs on the subject of demonstrators to the performance agreement for the 2022-2025 period. Interface recommends proceeding in this direction and seeking additional indicators to assess LIST's outcome and impact on the economy and society of Luxembourg.

Examples for possible additional KPIs are:

- KPIs as regards to impact in industry: number of industry projects, awareness of LIST among industry, coverage of the most important industry sectors in Luxembourg, satisfaction of industrial partners (e.g. measured through systematic debriefing sessions or via customer surveys)
- Qualitative or quantitative evaluation studies that allow measuring the institutes impact; evaluation studies may be based on case studies tracing the outcomes and impacts of typical projects with industry or the public administration.

**Recommendation 8: Design and implement career management support for staff**

In order to attract and retain excellent researchers, LIST needs to provide active and formalised career management support. Interface recommends designing and developing career development support for fixed-term staff as well as PhD students.

**Recommendation 9: Strengthen KTT activities with implementation of TTO office**

LIST initiated a joint TTO Office with LIH in 2020. By the time of the evaluation, the TTO had yet to be implemented due to recruitment issues. Interface recommends concentrating on the implementation of the TTO since it is seen as an essential support structure for the RDI department's KTT activities. At the same time, overlaps with the existing structures of the department's transfer support structures should be prevented. The TTO should, for example, address the following activities:

- The professionalisation of the institute's IP management
- The implementation of the LIST-wide spin-off policy (which exists as a draft version by the time of the evaluation)
- Support for EU project proposals for the RDI departments

# Appendices

## A 1 Departmental peer reviews

### I Evaluation teams

| Department   | Experts   |
|--|---|
| Department of IT for Innovative Services (ITIS)            | <ul style="list-style-type: none"> <li>– Prof. em. Dr. Dr. h.c. Heinrich C. Mayr, Professor emeritus &amp; Former president, Department of Artificial Intelligence and Cybersecurity (AICS), University of Klagenfurt, Austria</li> <li>– Prof. Dr. Florian Matthes, Professor of Software Engineering for Business Information Systems, Department of Informatics, Technical University of Munich (TUM)</li> <li>– Prof. Dr. Pierluigi Siano, Professor and Scientific Director of the Smart Grids and Smart Cities Laboratory, Department of Management and Innovation Systems, University of Salerno, Italy</li> <li>– Prof. Dr. Kilian Stoffel, President &amp; Professor of Data Management, University of Neuchâtel, Switzerland</li> </ul> |
| Department of Environmental Research and Innovation (ERIN) | <ul style="list-style-type: none"> <li>– Prof. Dr. Teresa Fitzpatrick, Head of Fitzpatrick Lab, Vitamins &amp; Environmental Stress Response in Plants, Department of Plant Sciences, University of Geneva, Switzerland</li> <li>– Dr. Serenella Sala, Deputy Head of Unit / Scientific Project Manager, European Commission, Land Resources Unit, Directorate of Sustainable Resources, Joint Research Centre, Ispra, Italy</li> <li>– Dr. Jan van der Eijk, Private Consultant &amp; Former chief Technology Officer for Shell, The Netherlands</li> </ul>  |
| European Space Resources Innovation Centre (ESRIC)         | <ul style="list-style-type: none"> <li>– Prof. Dr. Angel Abbud-Madrid, Director, Center for Space Resources and Space Resources Graduate Program, Colorado School of Mines, USA</li> <li>– Prof. Dr. Michelle Lavagna, Professor of Flight Mechanics, Department of Aerospace Science &amp; Technology, Politecnico di Milano, Italy</li> <li>– Prof. Dr. Tilman Spohn, Executive Director, International Space Science Institute (ISSI), Switzerland &amp; Former Director, Institute of Planetary Research, German Aerospace Center, Germany</li> </ul>   |
| Department of Materials Research and Technology (MRT)      | <ul style="list-style-type: none"> <li>– Prof. Dr. Paul Hartmann, Institute for Surface Technologies and Photonics, Joanneum Research, Austria</li> <li>– Prof. em. Dr. Louis Schlapbach, Empa &amp; ETH Zürich, Switzerland</li> <li>– Prof. Dr. Peter Schurtenberger, Department of Chemistry, Lund University, Sweden</li> <li>– Dr. Tessa ten Cate, Brightlands Materials Center, The Netherlands</li> </ul>  |

### I Departmental evaluation reports

- Rieder, Stefan; Büchler, Chiara (2023): Report on the evaluation of the IT for Innovative Services department (ITIS) at the Luxembourg Institute of Science and Technology (LIST), Interface Policy studies Research Consulting, Lucerne.
- Grosjean, Nicolas; Büchler, Chiara (2023): Report on the evaluation of the Environmental Science and Innovation department (ERIN) at the Luxembourg Institute of Science and Technology (LIST), Interface Policy studies Research Consulting, Lucerne.
- Rieder, Stefan; Büchler, Chiara (2023): Report on the evaluation of the European Space Resources Innovation Centre (ESRIC) at the Luxembourg Institute of Science and Technology (LIST), Interface Policy studies Research Consulting, Lucerne.
- Rieder, Stefan; Büchler, Chiara (2023): Report on the evaluation of the Materials Research and Technology department (MRT) at the Luxembourg Institute of Science and Technology (LIST), Interface Policy studies Research Consulting, Lucerne.

## A 2 Governance interviews

| <i>Level</i>                  | <i>Interview partners</i>  |
|-------------------------------|--|
| MESR                          | <ul style="list-style-type: none"> <li>– Robert Kerger, Government Commissioner</li> </ul>   |
| Board of Directors,<br>LIST   | <ul style="list-style-type: none"> <li>– Eva Kremer, Chairwoman, Deputy director of the Société Nationale de Crédit et d'Investissement (Luxembourg)</li> <li>– Etienne Jacqué, Vice-Chairman, Corporate R&amp;D manager at CEBI International SA (Luxembourg)</li> <li>– Tom Battin, Member, Professor at the Ecole Polytechnique Fédérale de Lausanne (Switzerland)</li> <li>– Candi Carrera, Member, Country manager at Microsoft Luxembourg (Luxembourg)</li> <li>– Letizia Lukas, Member, Managing director of exigo SA (Luxembourg)</li> <li>– Diane Wolter, Member, Chairwoman of the CBM Luxembourg Foundation (Luxembourg)</li> </ul> |
| Executive<br>Management, LIST | <ul style="list-style-type: none"> <li>– Thomas Kallstenius, CEO</li> <li>– Damien Lenoble, Director of Materials Research and Technology department</li> <li>– Laurent Cornou, Financial and Administrative Director</li> </ul>   |