

Report on the evaluation of the Computer Science  
and Communications Research Unit (CSC) at the  
University of Luxembourg

Based on a peer review as commissioned by the Ministry of Higher Education  
and Research of Luxembourg

Lucerne, 17 February 2017

COMPANY INFORMATION

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## Contracting authority

The Ministry of Higher Education and Research of Luxembourg

## Citation

Rieder, Stefan; Roose, Zilla (2017): Report on the evaluation of the Computer Science and Communications Research Unit (CSC) at the University of Luxembourg, Interface Policy Studies, Research, Consulting, Lucerne.

## Project reference

Project number: P15-66

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## I INTRODUCTION

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The Ministry of Higher Education and Research (MESR) of Luxembourg mandated *Interface Policy Studies, Research, Consulting*, Switzerland, to organize and lead a research evaluation of the University of Luxembourg. Simultaneously, the Institutional Evaluation Programme (IEP) of the European University Association carried out an institutional evaluation of the University of Luxembourg. The results of the IEP evaluation are published in a separate report.

The research evaluation was conducted in 2016 and followed two earlier evaluations carried out in 2008 and 2012.

The University of Luxembourg has three Faculties with research units conducting research in different scientific disciplines. In addition, there are three interdisciplinary centres.<sup>1</sup> The evaluation focused on the research performance of the University research units and interdisciplinary centres. This report presents the evaluation of the Computer Science and Communications Research Unit (CSC).

The observations and recommendations presented in this report are based on a peer review by the following three experts working in the research unit's research fields:

- Andreas Dengel, professor and chair of Knowledge Based Systems at TU Kaiserslautern, and member of the Management Board and scientific director at the German Research Centre for Artificial Intelligence (DFKI GmbH), Germany
- Colette Rolland-Benci, professor of information sciences at Panthéon Sorbonne University - Paris I, France
- Burkard Stiller, Prof. Dr., Department of Informatics, University of Zurich, Switzerland

The peer review consisted of a self-assessment report written by the CSC and a hearing at the research unit that took place in September 2016. The evaluation assessed the period 2012 to 2015. The hearing, which was organized and moderated by Interface, consisted of a self-presentation by the research unit, a group discussion of the self-assessment report, and several individual and group interviews. These included interviews with representatives of the management team, professors, PhD candidates,<sup>2</sup> and further members of the research staff. Based on the experts' assessments, the report was finalized by Stefan Rieder and Zilla Roose of Interface. The report has been approved by the experts.

<sup>1</sup> The Interdisciplinary Centre for Contemporary and Digital History was established in 2016. It is not part of the evaluation, as the assessed period is 2012 to 2015.

<sup>2</sup> The University of Luxembourg calls its PhD students 'PhD candidates'.

The overall results of all unit evaluations are summarized in a synthesis report.<sup>3</sup> The synthesis report includes the findings of the interviews conducted with representatives of the management team at the University of Luxembourg.

The report is divided into two parts: The first part discusses the expert team's observations gathered during the evaluation process. The focus is on the input, the output, and the outcome/impact of the research unit:

- *Input* includes the preconditions for the research conducted, such as strategies, financial and human resources, infrastructure, organization, and quality assurance systems.
- *Output* includes the performance of the research unit, exemplified through research results and their dissemination.
- *Outcome and impact* refer to the medium- and long-term effects as well as the relevance of the output for science, society, economy, and politics.

The second part presents the expert team's recommendations for further development of existing strengths and overcoming observed weaknesses.

*The evaluation team would like to thank everyone involved for preparing and implementing the hearing at the CSC, for making the documentation available, and for participating in interviews.*

<sup>3</sup> Rieder, Stefan et al. (2017): Evaluation of the University of Luxembourg, Interface Policy Studies, Research, Consulting, Lucerne.

## 2.1 OVERALL ASSESSMENT

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The experts' general perception of the CSC is positive. Their overall assessment of the academic output is very good; in the case of two subunits within the CSC their rating is excellent. The quantity of published papers is very good; however, the quality of the papers of some of the CSC members and groups shows room for improvement.

## 2.2 INPUT

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### Specific remarks

The CSC is affiliated with the Faculty of Science, Technology and Communication and is divided into four subunits conducting research in the areas of: (1) Communicative Systems, (2) Information Security, (3) Intelligent and Adaptive Systems, and (4) Software and Systems. The CSC collaborates closely with the interdisciplinary Centre for Security, Reliability and Trust (SnT), with which it shares common researchers as well as some research projects.

The team of experts would like to mention that the majority of the persons interviewed and the single project demonstration represented only two of the four subunits. Due to this situation, differentiation and individualization of all subunits were difficult for the experts.

### Research strategy

The experts acknowledge the excellent mixture of theoretical and fundamental research on the one hand and highly applied research on the other. Further, the academic freedom of the CSC to select any research topic is positively assessed. This includes explicitly the research unit's openness to political requests from the Ministry or suggestions from the University management regarding research areas. However, the experts agree that this openness entails a certain danger of engaging in research topics that are not within the core expertise of CSC researchers. This could lead to contradictions with respect to the expectation to generate research excellence.

Despite the positive assessment regarding choice of research areas, the expert team as a whole expresses critical comments regarding the research unit's strategy in general and their vision, mission, and objectives in particular. The experts gained the impression that the CSC lacks an overarching strategy. The individual subunit leaders appear to have well thought-out research agendas for their respective subunits, but no inter-subunit future strategy could be identified, especially for positioning the CSC as a whole. Related to this, also the vision, mission, and objectives of the research unit as a single entity remain largely unclear (see also section 2.5).

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

First and foremost, the experts emphasize the excellent working conditions and the good administrative support that the CSC provides to its members. These conditions

facilitate the unit's research activities by relieving its members of having to struggle with organizational and administrative issues.

Regarding financing opportunities, the experts share the impression that the CSC operates on the basis of a reasonable and fair level of University funding, which is rare in this extent among university institutions around the world and which constitutes an important competitive advantage for the research unit.

With respect to human resources, the experts state that the CSC has many highly qualified and experienced researchers. In terms of employee satisfaction, the conveyed impression is that the researchers are not only happy but also proud to be members of the CSC. This very high degree of satisfaction and shared identity holds for all hierarchical levels. Accordingly, the experts assess the atmosphere and working culture at CSC as very pleasant.

In terms of future prospects, the majority of CSC members are confident and rate the career perspectives of CSC graduates as promising in both academia and industry. PhD candidates' assessment of the supervision of their educational programmes is very positive.

However, an issue rated negatively by the experts is the lack of a clear career development plan. Another aspect raised at the hearing was the limitation of non-permanent positions to five years, regardless of the qualification level of a PhD candidate or postdoc. The experts doubt that this rule is advantageous for the University in general and the CSC in particular. For instance, PhD candidates that are promoted to a postdoc position due to their excellence can contribute to the CSC's merits for a maximum of only 12 additional months, assuming they completed the PhD in four years at the University of Luxembourg.

#### Organization

Irrespective of its at least partly beneficial nature, the relationship between the CSC and the SnT and related consequences was a question that came up repeatedly throughout the hearing. It became clear that CSC members serve the SnT, which depends on the CSC. However, the experts also observed that not all CSC members contribute to the SnT, but they could not detect any underlying rule or principle of inclusion or exclusion at either institution.<sup>4</sup> The question as to how the collaboration manifests itself in daily University life could not be clarified within the scope of the hearing. Accordingly, the experts have the impression that it is not possible to clearly distinguish between the two institutions and their outcomes, which would be essential in order to evaluate the CSC independently. In contrast to the experts, CSC members do not consider this organizational interdependency to have any problematic influence on output.

Overall, the experts assess the collaboration between the CSC and the SnT as a positive aspect of the organization, due to it being beneficial for: (a) both institutions, and (b)

<sup>4</sup> Retrospectively, the research unit gave the following statement regarding this issue: "The past and current CSC policy is that CSC professors themselves may decide whether and to what degree they want to be associated with the SnT."

the University as a whole. The CSC both offers services to the SnT as an interdisciplinary centre but also profits from the SnT and its infrastructure.

#### External research collaboration

In terms of collaboration projects with other University entities, the experts acknowledge existing collaboration within the University of Luxembourg but also with national as well as international research groups. Nevertheless, the experts encourage the CSC to broaden its scope of collaboration especially within the University of Luxembourg, where they consider the focus to be primarily too one-dimensionally directed towards the SnT.

#### Quality assurance system

The experts rate the quality of research by the CSC as very high. Since an overall quality assurance system is missing, this is presumably not the result of a CSC-wide quality assurance plan and monitoring of the excellence of the unit's research. Although the subunit leaders state that they individually record selected quality dimensions within their respective subunits, this is not carried out on the level of the entire unit. The expert team strongly encourages the leaders of the subunits and the head of the CSC to identify the list of dimensions by which the quality of academic output can be evaluated coherently across all subunits. The resulting indicators should be updated frequently in view of developing scientific areas. In preparation for the hearing, the CSC recorded the number of publications. However, besides this purely quantitative information, a collection of qualitative dimensions is of interest, such as impact factors, number of spin-offs, jobs, financial resources, career indicators for PhD candidates, and cooperation with industry.

## 2.3 OUTPUT

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All in all, the experts consider the performance of the CSC to be good, its scientific record outstanding, and the research unit as such very strong.

The experts assess the quantity of publications of CSC as very high. Regarding the quality of the publications, the expert team acknowledges that some of the subunits deliver research of high quality, which is underlined by best paper awards granted to the respective researcher or teams. In particular, two of the subunits perform very well in terms of output quality and quantity. It is obvious to the experts that not all of the four subunits produce output on the same quality level.<sup>5</sup>

When assessing output, it has to be considered that the CSC and the SnT proved to be very tightly woven together (as mentioned above in the section 'Organization'). Due to this obvious fact, it was not transparent to the experts which part of the research explicitly originated from the CSC with: (a) no, (b) minor, or (c) major influence by the SnT. Accordingly, the experts could not recognize the individual contribution of the CSC research unit as a whole and all of its members. As a result, it remained unclear to

<sup>5</sup> The experts reached this conclusion based on the following criteria: (1) the number of best paper awards, (2) the quality level of conferences and journals, and (3) the number of invited keynote talks.



the experts in what sense the CSC is unique and differentiable from the SnT in the research dimension and what the key performance indicators of the CSC are with respect to scientific output. The presentation given by CSC members and all of the interviews conducted (individual or in groups) did not clarify this issue; consequently, it was not possible to keep apart SnT-contributing and non-SnT-contributing CSC members and their dedicated outputs. Nevertheless, from the perspective of CSC researchers there is no problem using both channels (CSC and SnT) to justify their output quality.

The experts note positively the high number and the interdisciplinary scope of large and innovative projects within the research unit. Some of the four CSC subunits demonstrate continuous collaboration in the form of joint projects with other CSC subunits, which is strongly appreciated by the experts. As pointed out above in the section ‘Input’, almost all of the CSC members interviewed are members of only two of the four subunits. Therefore, it was only possible for the experts to gain more detailed insights into the performance of these two subunits, based on individual interviews, group discussions, and the single demonstration of the CSC’s research. The experts are of the opinion that the two subunits that were predominantly represented in the hearing are outstanding. However, the experts wish to emphasize explicitly that they did not receive sufficiently detailed oral information during the hearing on the two remaining subunits to be able to assess their research performance on a reliable basis.

In terms of innovative performance, it can be stated that up to the time of the evaluation, spin-offs and patents were a side effect of the interrelated SnT/CSC work. However, the experts share the impression that awareness concerning addressing and supporting spin-offs is increasing and that CSC members will consider this dissemination channel more strongly in the future. The experts encourage the research unit to move in this direction. At the same time, based on the experience of the experts, software patents are a difficult topic in computer science and are considered to hinder the ‘time-to-market’ aspect. The experts thus agree with the research unit head that CSC should not focus on that kind of outputs.

## 2.4 OUTCOME AND IMPACT

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The experts rate the CSC as a unit with a very good standing overall and very good recognition inside and outside Europe. Some of the leading researchers at the CSC are well connected internationally, contributing to editorial boards and committees as well as chairing conferences. In general, the subunits show good performance in terms of international projects, but it is also obvious to the experts that not all of the subunits are contributing equally to international communities through active participation and through the impact of their publications. The experts explicitly encourage all of the subunits to participate in international networks and scientific communities in order to increase the visibility of the CSC.

The experts agree that the research and work topics addressed by the subunits complement each other well in covering the main line of research in computer science. These visible research areas reveal both synergies and a very high potential to address challenging research questions in the future. This specifically holds for fields such as

energy-aware cloud computing and communications as well as ad-hoc networks, privacy and location-based services, Android applications, website fingerprinting, security of socio-technical systems, electronic voting, and scheduling problems.

The experts state that some examples of CSC collaboration with industry show a recognizable impact of CSC work on the local IT society of Luxembourg. Particularly suited examples are collaboration with *Société Européenne des Satellites* (SES) and Mixvoip. Moreover, there is valuable collaboration with industry abroad, such as with Daimler, BMW, and Microsoft, which allows for international visibility and increasing impact of CSC work.

In terms of outreach, the experts state that some of the results of the CSC have a remarkable positive impact on society, both nationally and internationally. Here, the *Prêt à Voter* election system is an excellent example. The remarkable transfer rate of young talents, educated within the CSC, to major companies further reflects this positive impact. It is important to mention that CSC staff members are aware of the fact that local industry provides interesting career opportunities to them (53% of PhD graduates and 68% of postdocs at the Communicative Systems Laboratory (ComSys) subunit remain in Luxembourg after leaving the CSC<sup>6</sup>).

## 2.5 STRATEGY FOR THE FUTURE

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As elaborated above in the section ‘Research strategy’, it was not possible for the experts to identify a shared strategy for the future of the CSC that can be implemented today. The recent change in the head of the CSC needs to be taken into account; the experts expect that the new head of the research unit will soon promote development of the strategy. A first step had already been made at the time of the hearing, in that the self-assessment report prepared for the evaluation contains a section on a possible but still incoherent future CSC strategy.

The experts note that as a consequence of this lack of a common future strategy, the four subunits of the CSC work and plan widely independently of each other. Accordingly, each subunit is concerned with its own individual future instead of the shared future of the CSC. The experts indicate that apart from a few examples, collaboration between the subunits and the sharing of an overarching CSC-strategy are relatively weak. This complicates internal and external perception of the CSC as a cohesive entity.

The experts note that the CSC is strengthening its competencies by integrating a new professor in the field of big data, which in the view of the experts is well fitting and complementary to the other research areas. Members of the CSC appear to be very enthusiastic about the new colleague. Nevertheless, the experts state that in order to make this new professorship a success, the expectations of this research area, its contribution to the vision and mission of the research unit, and its scientific integration in the CSC as a whole have to be clarified.

<sup>6</sup> So far, no statistics have been collected for the other subunits.

The experts do not expect that the CSC has to formulate the development of a full-fledged computer science research plan in its strategy. However, they encourage the research unit to consider a new professorship in the research field of innovative machine learning technology to strengthen this emerging field in computer science. The experts suggest concentrating on emerging areas, such as deep learning, reinforcement learning, and transfer learning, since they complement the existing competences and provide new options of synergistic projects not only with the new professor in the big data field.

### 3.1 SUMMARY

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In summary, the experts assess the CSC as a strong research unit of which several high profile researchers are members. The overall conditions in terms of infrastructure, financial settings, and the free choice of research topics provide an excellent grounding for research. The quantity of output is outstanding; however, there are visible discrepancies between the subunits in the quality of output. A potential obstacle to the overall and unified success of the research unit is the absence of a common strategy for the CSC and the lack of team spirit. Up to the time of the hearing, the process of formulating a common strategy was just about to be started. It remains unclear how attached the CSC and the SnT and their researchers are to each another, which made it very difficult for the experts to assess the final performance of the CSC separately.

All in all, the experts share the opinion that the research unit offers excellent working conditions, provides very good research, and is on a good development path. Once a joint strategy and career planning for young researchers is implemented, the research unit will have the chance to strengthen its excellent position and to emphasize its nationally and internationally recognized position.

### 3.2 RECOMMENDATIONS

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Based on the observations stated above, the experts formulate the following recommendations for the research unit, the University, and the MESR:

#### Recommendation 1: Develop a strategy for the CSC

The experts appreciate the initiated process of developing a strategy for the entire research unit, which they consider to be of vital importance for the CSC to make further progress. As this process has just started, the experts strongly emphasize the importance of continually evolving the CSC strategy under the guidance of the head of the research unit. The future strategy should include at least the following elements:

- Vision and mission, elaborated by the head of the CSC and the four subunit leaders;
- Roadmap with short-, mid-, and long-term challenges and deliverables of the four subunits to the vision and mission of the CSC, as an instrument to make the strategy visible;
- Clarification of the role and the research focus of the new professorship for big data analyses;
- Concrete plan on how the strategy will be implemented and monitored by the CSC management.

#### Recommendation 2: Diversify collaboration other than with the SnT

In its core and in principle, the experts support a very close link between the CSC and the SnT. Nevertheless, they encourage the CSC to strengthen ongoing collaboration with other units, centres, and institutions inside and outside the University and also to seek and build new relationships. Particularly the deepening of existing cooperation with the research groups in Law, History, Life Science, Biomedicine, and Fintech should be pursued intensively.

#### Recommendation 3: Improve career management of PhD candidates and postdocs

The experts acknowledge the very good atmosphere and working conditions for PhD candidates and postdocs at the CSC. This is a key strength of the research unit. To reinforce this position, the experts recommend improving the career management of PhD candidates and postdocs explicitly. The CSC is recommended to establish a form of continuous dialogue based on HR instruments. By means of this dialogue, the leaders of the subunits and supervisors of PhD candidates will be able to support the career development of PhD candidates and postdocs and their transfer to other research institutions or to industry, which is important for the impact of the CSC on the economy of Luxembourg.

#### Recommendation 4: Develop a monitoring system with success criteria for the CSC

In the experts' opinion, the contributions to science and practice by the CSC are insufficiently accountable to the research unit due to overlaps in content and output. The research unit's performance is thus not sufficiently visible to the University management and the MESR. The experts therefore recommend the development of a monitoring system for scientific results and transfers to industry or the outside, in order to clearly demonstrate the achievements of the CSC. This monitoring needs to provide relevant information about the research unit as a whole but also on the level of the subunits. Besides already recorded indicators (e.g. publications, awards, and impact factors), additional indicators, such as career metrics for PhD candidates and cooperation with industry, need to be included in the monitoring system.

#### Recommendation 5: Consider a new professorship on innovative machine learning technology

The experts recommend extending the existing portfolio of the CSC by creating a new professor position. This new professorship should focus on the field of efficient and scalable machine learning approaches. This is not only because this research field has gained a lot of attention due to its successes in a variety of commercial applications but also because of the high potential for collaboration with the well established research groups in Law, History, Life Science, Biomedicine, and Fintech. When creating the professorship, the experts recommend considering appropriate financial resources to provide the required hardware for developing the needed technology and to run big data applications. Such a position should furthermore come with several positions at the intermediate level (e.g. postdocs) and corresponding office space.