INTERFACE

Report on the evaluation of the Interdisciplinary Centre for Security, Reliability and Trust (SnT) 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

TABLE OF CONTENTS

I   INTRODUCTION

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.[1] The evaluation focused on the research performance of the University research units and interdisciplinary centres. This report presents the evaluation of the Interdisciplinary Centre for Security, Reliability and Trust (SnT).

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

-   Bart De Moor, professor at Dept. Electrical Engineering, KU Leuven, Belgium

-   Christer Norström, working chairman of WeMeMove AB and adjunct professor at KTH Royal Institute of Technology, Sweden

-   Colette Rolland-Benci, professor of information sciences at Panthéon Sorbonne University - Paris I, France

-   Burkhard Stiller, professor, Department of Informatics, University of Zurich, Switzerland

The peer review consisted of a self-assessment report written by the SnT 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 interdisciplinary centre, 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,[2] and further members of the research staff. Based on the experts' assessments, the report was finalized by Stefan Rieder and Kristin Thorshaug of Interface. The report has been approved by the experts.

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[1]   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.

[2]   The University of Luxembourg calls its PhD students 'PhD candidates'.

The overall results of all unit evaluations are summarized in a synthesis report.[3] 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 SnT, for making the documentation available, and for participating in interviews.

The experts would especially like to commend the SnT for their professionalism in the oral presentation, the interviews, the demonstrations, and the organization of the hearing.

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[3]   Rieder, Stefan et al. (2017): Evaluation of the University of Luxembourg, Interface Policy Studies, Research, Consulting, Lucerne.

2   RESULTS OF THE EVALUATION

2.1   OVERALL ASSESSMENT

The experts acknowledge the high performance of the SnT and its outstanding record of industrial collaboration. The interdisciplinary centre has had a remarkable development since its launch, with both its research activities and its impact. The centre is a successful cornerstone of the University of Luxembourg's portfolio, and the experts consider the position of the SnT within the University to be a role model for future interdisciplinary centres.

2.2   INPUT

Specific remarks
The SnT was created in 2009 as the first interdisciplinary centre at the University of Luxembourg. It was established to implement the strategic plan to increase the competitiveness of and diversify the economy of the country. The SnT conducts high-risk and long-term research activities in information and communication technology (ICT), especially in terms of security, reliability, and trust aspects. At the end of the evaluation period in 2015, the SnT was divided into eight separate research groups. The SnT is organized at the same level as the Faculties of the University, and it operates with a top-down governance and management structure. The SnT is composed of researchers (postdocs and PhD candidates) hired directly by the centre and researchers from different research units at the University of Luxembourg. The latter group is mainly from the research unit Computer Science and Communication (CSC) but also other units, such as the research unit Engineering Science (RUES) of the Faculty of Science, Technology and Communication (FSTC) and the research unit Education, Culture, Cognition and Society (ECCS) of the Faculty of Language and Literature, Humanities, Arts and Education (FLSHASE).

Research strategy
The experts state that Luxembourg has been successful in its strategic plan to establish an interdisciplinary centre aiming at knowledge transfer and competitiveness. In that context, the SnT is able to attract world-leading scientists to Luxembourg, and its portfolio of strategic research areas and research groups is impressive. The SnT's dynamic strategy resonates with the dynamic character of the national industry. The SnT researchers demonstrate a clear understanding of their national as well as international competition and are fully committed to the mission and objectives of the SnT. The SnT's research areas are well defined and fit with the needs of the Luxembourgish society. Nevertheless, the experts identify an opportunity for the centre in the pressing need for expertise in machine learning and big data (see sections 2.5 and 3.2 below).

Human and financial resources, infrastructure, and equipment
The working conditions at the SnT are assessed as excellent. This is also the case with respect to available human and financial resources. The experts call special attention to

the SnT's success in attracting external financial resources, which constitutes an important foundation for research of high quality and quantity (see section 2.3 below).

The experts identify potential for optimization in three areas of an organizational nature:

1. The experts identify shortcomings concerning human resources management at the SnT. First, statements from the researchers interviewed reveal uncertainty concerning their career paths and promotion possibilities. Second, the experts note that a majority of positions at the SnT are temporary. This approach secures flexibility but at the same time hampers continuity of research activities. The experts encourage the SnT to increase the percentage of permanent positions. Furthermore, legal advice is needed to provide the right type of longer-term contracts for researchers who earn their PhD at the University of Luxembourg and are excellently qualified to continue as senior researchers. Third, at the time of the evaluation the centre relied on a smaller number of excellent researchers in strategically important areas. Thus, to increase SnT's sustainability within these areas and beyond, steps need to be undertaken. Fourth, the experts have observed that the number of female researchers is very low, and no strategy concerning gender policies was identified.

2. The SnT has been successful in recruiting candidates of high and in part very high quality on all levels (professors, research associates, and PhD candidates). However, the hearing revealed important problems in recruitment processes, especially for potential PhD candidates from outside the EU. The University's formal human resources recruitment process takes too long, which entails a strong risk of losing excellent candidates. The experts suggest analysing and clarifying procedural deficits with the University and related ministries, especially with respect to the time-intensive procedures upon recruitment, and recommend implementing measures to improve this situation.

3. The SnT is fragmented physically across two locations: the Weicker building and a building on the Kirchberg campus. As an important consequence, a lack of communication between these dispersed research groups and researchers of the centre has to be coped with. This serious fragmentation problem will be a continuing issue once the University carries out the planned move in the fall of 2016 to the JFK Building and Campus Belval; this will result once again in two locations, which are geographically even further apart than the locations today.

Organization

The experts note that the SnT operates a well-functioning organization with a well-designed internal structure. The internal administrative support through the SnT office is very good, with support in e.g. financial management, submission of research proposals, monitoring, acquisition of projects, and marketing. The experts value the fact that the SnT's culture is based on a dynamic and 'the-limit-is-the-sky' mentality. This culture is induced and maintained by a strong leadership team. The experts express respect for the complementary tandem position developed, which functions well between the director and the vice-director of the centre. The experts emphasize the fact

that the culture of the SnT has to be cultivated by all stakeholders as an important asset of the centre.

The experts rate the collaboration between the SnT and the CSC as good. This is mainly due to the fact that a majority of the professors at SnT are affiliated with the CSC and are research group leaders at the SnT. However, the relationship between the SnT and the FSTC raises concerns. The experts discovered that not all SnT senior researchers and group leaders are full members of a Faculty and as such are excluded from decision-making processes at the Faculty level. This lays the basis for conflicts in the collaboration between the SnT and the Faculty due to different perspectives on obligations and responsibilities, which are perceived differently by the SnT and the Faculty in the areas of research, strategy, management, and teaching.

External research collaborations and service provision
The SnT has had a remarkable development in its collaboration with industry, launching over 25 strategic partnerships within its Partnership Programme. The impressive success within EU programmes allows the SnT to cooperate with excellent academic and industrial partners across Europe. Especially the strategy of the SnT to define projects with industry as strategic research programmes secures sustainable collaboration projects, which today are not simple to secure. Regarding further industry collaboration for the SnT, the experts identify additional project opportunities in the banking sector as well as in media-intensive companies and note that the SnT has already started to explore potential collaborations within these sectors.

The SnT adheres to a feedback model in which the societal and industrial pull is confronted with scientific and technology push.[4] It includes a process for eliciting new scientific and technological knowledge through an effective and collaborative model of research and innovation. The experts give this feedback model a positive rating, since its focus on impact is positive for the work of the centre and strengthens the establishment and transfer of knowledge.

Quality assurance system
The SnT has an effective quality assurance system in place. The governance of the SnT is assessed as excellent, with its strategic plan with a multi-year perspective, annual activity plans, and review processes, including detailed, goal-driven, and quantity-based monitoring based on primary and secondary key performance indicators.

2.3   OUTPUT

The experts confirm that the scientific production of the SnT is excellent, with publications in internationally leading journals and refereed contributions at a large variety of international conferences. Although selected research groups and individuals have a much higher number of publications than others, the average level of academic production across the research groups is very good. Despite the overall positive impression of

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[4]   See the graphical representation of this model in Figure 1 (Appendices). In contrast, the classical model of innovation is linear, going

from fundamental research to basic research to applied research.

the research output, the experts note a clear heterogeneity between the different research groups not only in quantity but also in quality of the output. This strengthens the need for an instrument to monitor the quality as well as the impact of the output. The experts acknowledge the fact that the SnT is currently in the planning phase of developing an instrument of that kind.

The experts acknowledge the outstanding record of external and competitive funding acquisition at the centre. The SnT has had remarkable success obtaining funding from the Luxembourg National Research Fund (FNR) and also from the EU Horizon 2020 programme, acquiring nine projects within 12 calendar months. The role of the SnT in European research programmes, the acquisition of a European Research Council (ERC) grant and FNR PEARL grants,[5] and collaboration with the European Space Agency (resulting overall in 20 projects) all clearly demonstrate also the high quality of the output of the centre.

The SnT does not carry responsibilities for teaching programmes but participates in teaching and managing study programmes as well as in the Doctoral School of Computer Science and Computer Engineering (DS-CSCE). The experts note that during the hearing, a number of SnT members expressed their willingness to participate in teaching activities. Potential areas of conflict are addressed above in the section 'Organization'.

The experts rate highly the external interdisciplinary research conducted by research groups of the SnT, for example the output produced through their collaboration projects linked to museums, biobanking, and e-learning.

Collaboration with industry accounts for a large amount of the output of the SnT. The experts identify an outstanding record of industrial collaboration at the centre. They would like to emphasize that industrial projects are highly demanding due to the fact that: (1) problems offered to the SnT are scientifically and technologically challenging and typically unsolved within industry, (2) there are well-defined deadlines, and (3) there is clearly defined content and specific deliverables. The impressive growth of the SnT's project portfolio, which is very clearly visible in the increasing financial turnover over the years, demonstrates impressive output of the centre.

Technology transfer is an important element within the SnT. Despite the fact that patents are not key in software development and computer science in general, the experts assess the centre's performance with respect to patenting and licensing as good. Because of its intense interaction with industry, the Board of Governors at the University of Luxembourg initialized the creation of a pilot Technology Transfer Office (TTO) at the SnT. The experts support this initiative and suggest granting the SnT autonomy in the development of this TTO. This can support the development of new models of interactions, provide incentives for all stakeholders involved, enable the

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[5] The PEARL programme is directed at public research institutions in Luxembourg and leading research professionals abroad. The goals of the programme are to recruit internationally leading researchers with outstanding track records and thereby to strengthen the research areas that are of strategic importance to Luxembourg. PEARL projects have a lifespan of five years with a financial contribution of between three to four million euros by the FNR (see <www.fnr.lu>).

creation of spin-offs, support the establishment of bilateral contracts with third parties, and – where applicable – foster patents and especially licences.

2.4   OUTCOME AND IMPACT

In its specific research areas, the SnT is on a growth path to excellence as benchmarked in comparison to similar international research centres and groups. Based on the documentation made available and the interviews at the hearing, the experts acknowledge the intensive collaboration with industry that very clearly illustrates the socio-economic impact of the SnT in Luxembourg and abroad. The experts agree that in due time, the SnT can grow into an internationally established centre of excellence in the areas of security, reliability, and trust.

Of the researchers that have been recruited by the SnT, 94% originate from abroad.[6] Almost 40% of SnT alumni have chosen to stay in Luxembourg, taking up work in local industry, academia, or the public sector. The experts note that through its recruitment of international scientists and PhD candidates of high quality and the further activities of SnT alumni in Luxembourg, the SnT has a measurable impact on society, industry, and the economy of Luxembourg, helping to build a highly skilled workforce within the ICT domain and related application fields.

Although the SnT is developing its visibility nationally and internationally, the experts identify important potential for further development of the brand 'SnT', especially in the international research community beyond Luxembourg. In part, this may be achieved implicitly through its researchers (and this is already happening), who act as the centre's ambassadors, attract international visitors, organize internationally visible events, and publish high-impact publications. In the interviews, all of the researchers at the SnT expressed their willingness and motivation to take on this challenge. The experts encourage SnT members to do so.

2.5   STRATEGY FOR THE FUTURE

Through the creation of the SnT, Luxembourg has given a boost to its mission to secure basic and applied research in security, reliability, and trust. The experts acknowledge explicitly that the domain of the SnT is dynamic and prone to change and thus demands a dynamic research strategy. Still, the SnT is encouraged to develop a long-term vision for the identification of new and upcoming strategic research activities. This includes the implementation of monitoring mechanisms and the deployment of a fully operational TTO, as mentioned above.

The experts identify big data and machine learning as important future research areas in the domain of the SnT. The centre is encouraged to plan for recruitments in these areas. The profile to be recruited should focus not so much on theoretical develop-

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[6]   Fifty-nine percent are EU nationals, and 35% originate from outside the EU (source: self-presentation by the SnT at the hearing).

ments in machine learning but more on the research and development areas that are covered by the SnT itself.

The SnT is visibly supported by the Ministry, by industry partners, and by its own employees. In its future strategy, the experts recommend that SnT continue to benefit from opportunities of society and industry in Luxembourg. At the same time, the centre has to make use of opportunities offered by the University of Luxembourg. All of these include, among others, available block grants, the possibility to teach, supervision of PhD candidates, and other facilities as well as resource support.

3   SUMMARY AND RECOMMENDATIONS

3.1   SUMMARY

The SnT has had a remarkable development since its launch in 2009, both in its research activities and its impact. The experts find that the SnT's portfolio of strategic research areas and research groups are well-defined and that they fit the needs of the Luxembourgish society well. The centre demonstrates a well-functioning organization and very good working conditions. The SnT has an outstanding record of industrial collaboration and excellent scientific production, and it has had impressive successes in acquiring funding in very competitive channels (e.g. industry, Horizon 2020, ERC, and PEARL). Especially the intensive collaboration with industry clearly illustrates the socio-economic impact of the SnT in Luxembourg.

Given the important mission of the SnT in the Luxembourgish society, the centre as well as its stakeholders are encouraged to work towards maximization of the SnT's potential. Among other things, there is potential for optimization in the relationship between the SnT, the University of Luxembourg management, and the FSTC.

3.2   RECOMMENDATIONS

Based on the observations stated above, the experts formulate the following recommendations for the SnT, partially in close collaboration with the FSTC, the University, and the MESR.

Recommendation 1: Continue to support the SnT

The creation of the SnT has been a success story in the evaluation period 2012-2015, as it has given Luxembourg the possibility to establish a centre of excellence in a strategic research domain. The model of an interdisciplinary centre of this kind, focusing on extensive collaboration with industry, has proven successful at combining research with development and recruitment in industry at the national and international levels. The experts recommend that all stakeholders, relevant ministries, the University of Luxembourg, and industrial partners offer their continued and explicit support and endorsement of the mission of the SnT.

Recommendation 2: Strengthen links between the SnT, the University management, and the Faculties

The experts recommend that the SnT together with the University of Luxembourg establish a common set of core guidelines concerning the role, responsibilities, duties, and values of interdisciplinary centres of this kind. Possible paths for Faculty recognition of SnT researchers should be discussed, including (1) appointing SnT researchers as members of a Faculty and giving them co-determination rights in decision-making processes at the level of the Faculty, and (2) assigning SnT researchers teaching duties on the bachelor's level.

Recommendation 3: Secure a long-term facility solution

In the external evaluation of the University of Luxembourg published in 2013, the evaluation panel recommended improving the facilities of the SnT, as the geographic dispersion of the centre's research groups was an obstacle to its development. As this is still an identified challenge in 2016, the experts recommend that the SnT in collaboration with the University develop a mid-term and sustainable facility solution for an integrated geographical location of all research groups. Concentrating the human resources at one location will lead to better cross-fertilization and interaction within the centre and – depending on the final location – with the FTSC especially and with others.

Recommendation 4: Secure the autonomy of SnT

Together with the University of Luxembourg and the Faculty level, the SnT needs to develop a solution to increase the critical mass in permanent staff and as such the mid-term sustainability of the centre. The solution may include increased autonomy of the SnT in the relationship with the University and the FTSC, while considering recommendation 2. The experts recommend that the SnT be granted autonomy to put in place flexible governance structures, including increased independence in academic recruitment.

Recommendation 5: Implement promotion possibilities

The experts recommend that the SnT develop a dialogue procedure and the necessary instruments to assist its employees in developing their career plans. The experts further recommend that the SnT implement promotion possibilities within the University system that are financed by the SnT. In this context, the five-year contract limitation should be discussed with the Ministry, as this is a significant limiting factor in the promotion possibilities of the SnT.

Recommendation 6: Further develop the Technology Transfer Office

The experts appreciate the establishment of a Technology Transfer Office (TTO) in the SnT. As this TTO is considered to be a pilot, the experts recommend further development and consolidation, with the following elements as key factors: First, the SnT needs to secure complete transparency in financial flows from the TTO to the University of Luxembourg and from the TTO to researchers, defining the percentage share that remains with individual research groups besides University overheads – all under a well-balanced incentive scheme for all stakeholders involved. Second, these incentives have to be quantified and implemented for researchers contributing to technology transfer. Third, the TTO has to have a continued place in the SnT, and the centre needs to achieve autonomy in the implementation of this model. During implementation, the SnT needs to ensure that the TTO remains close to its research fields and practices, that it follows a bottom-up driven model, and that there is a well-communicated quality metric in the support offered.

Recommendation 7: Develop research areas

The research areas of big data and machine learning are defined as key and new areas in the development of the research domain of the SnT. The experts appreciate that the SnT is already taking measures to secure the recruitment of qualified personnel in these areas. However, they recommend that the SnT develop a strategy for recruiting quali-

fied personnel in the research areas mentioned, basing the recruitment steps on major requirements of the SnT. Key aspects have to be application-oriented research as well as an orientation of research areas towards suitable candidates.

Recommendation 8: Develop a gender policy

There is an emerging need for a gender policy in the recruitment strategy of the SnT. The experts recommend that the SnT develop a programme to attract female researchers. This programme has to include the recruitment of female experts for leading positions within the SnT.

A P P E N D I C E S

Figure 1: SnT feedback model of research and innovation

Innovation & Development

Basic Research	Applied Research

(SnT Scientists)
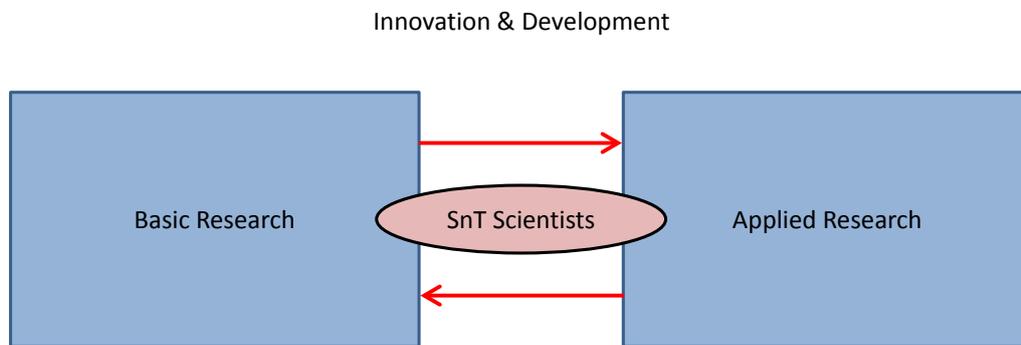
Source: Based on the self-presentation by the SnT at the hearing.