RESEARCH AND INNOVATION SMART SPECIALISATION STRATEGY (RIS3)

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1 INTRODUCTION

Smart specialisation is an innovative, context specific and place-based approach that aims to boost growth and jobs in Europe, by enabling each member state and / or region to identify and develop its own competitive advantages and hence, prioritise research and innovation investment in its specific competitive areas.

This document details a research and innovation Smart Specialisation Strategy (RIS3) cognisant of the specific economic context of Luxembourg within its unique place setting at the heart of the European Union, surrounded on all sides by strong economic partners, and with one of the most open economies in the world and the most open market in Europe.

This is the second cycle of the Luxembourg RIS3 process and builds on the first report presented in 2013[1]. In addition, in line with best practice, the final strategy retained, significantly leveraged a deep collaborative Luxembourg reflection over 18 months, using a bottom-up approach and, actively involving over 300 diverse national stake-holders, and working groups from all facets of Luxembourg society, facilitated by the Rifkin TIR Consulting Group. The work was conducted in tandem with country-specific macroeconomic data, resulting in a tailor-made study adapted to local realities. In other words, a place-based smart specialisation strategic framework. The result being a vision, narrative and game plan to usher in a smart green digital Luxembourg society[2].

Chapter 2 presents a global and European picture of the innovation setting within which Luxembourg operates and, more particularly, given the goal to create a smart green digital society, the current positioning of Luxembourg in the global digital race for economic growth.

The Luxembourg government programme established in 2013 placed special emphasis on diversification of the economy and privileged innovation initiatives in key sectors. The revised smart specialisation strategy presented in this document is firmly anchored in this larger national innovation strategy and economic perspective, as discussed in Chapter 3. It represents an update in the programming and definition process of the strategic priorities to support innovation in the frame of the ERDF 2014-2020 programme. A range of programmes and policy delivery instruments are used to enable this Luxembourg industrial and essentially digital enabled innovation strategy. Specific experimentation and optimization over the past RIS3 period 2015-2017 is described in Chapter 4.

The Ministry of the Economy is the managing authority for the implementation of the Luxembourg RIS3 strategy. However, as discussed in Chapter 5, the RIS3 governance is characterised by several instances of coordination and consultation amongst the four principal actors of the Luxembourg innovation ecosystem; government, industry, pubic research and education actors and, civil society. The ongoing monitoring and evaluation system is detailed in Chapter 6.

Finally, Chapter 7 presents an outlook towards the future evolution of the Luxembourg RIS3 recognizing that as we approach the start of the third decade of the 21st century digitisation will reshape industry and competiveness throughout the world.

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1 *"Luxembourg Strategy for Smart Specialisation" http://s3platform.jrc.ec.europa.eu/regions/LU*

2 *The Third Industrial Revolution strategy study for the Grand Duchy of Luxembourg; www.tirlux.lu*

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2 NATIONAL CONTEXT

2.1 Global positioning of Luxembourg

Smart specialisation is a context specific and place-based approach that facilitates member states to prioritise research and innovation investments in its specific competitive areas.

This chapter provides an overview of the specific economic and innovation context of Luxembourg within its unique place setting at the heart of the European Union, surrounded on all sides by strong economic partners with one of the most open economies in the world and the most open market in Europe.

Over the past two years, the Luxembourg government has engaged in a deep collaborative reflection, facilitated by the Rifkin Consulting Group, to develop a game-plan to usher in a smart green digital society, paving the way for a nationwide deployment of a Third Industrial Revolution transition. This new strategy positions Luxembourg as a flagship nation in the European Union build-out and scale up of a smart sustainable digital society.

The Luxembourg government therefore pays particular attention to both the global economic and innovation setting within which Luxembourg operates and more particularly, the current position of Luxembourg in the global digital race for economic growth.

IMD World Competitiveness Ranking 2017

The IMD World Competitiveness ranking[3] benchmark the performance of 63 economies based on more than 340 criteria measuring different facets of competitiveness. In this year's 2017 IMD World Competitiveness Yearbook, Luxembourg has climbed up three ranks to 8th place worldwide and, ranked 4th amongst European Union member states.

World Economic Forum's Global Competitiveness Report 2017-2018

The Global Competitiveness Index (GCI[4]) tracks the performance of 140 countries on 12 pillars of competitiveness. It assesses the factors and institutions identified by empirical and theoretical research as determining improvements in productivity, which in turn is the main determinant of long-term growth and an essential factor in economic growth and prosperity. In the 2017-18 report rankings, Luxembourg is in 19th place, up from 20th the previous year, and in 8th place within the European Union.

Global Innovation Index (GII) 2017

The Global Innovation Index[5] is devoted to measuring the innovation performance of 127 economies around the globe. In the 2017 edition of the GII, 15 of the top 25 economies come from Europe. Luxembourg is ranked 12th globally and 8th within the European Union.

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3 *https://www.imd.org/wcc/world-competitiveness-center/*

4 *https://www.weforum.org/reports*

5 *https://www.globalinnovationindex.org/*

2.2
Positioning in the digital economy

Digitization will reshape industry and competitiveness throughout the world. Luxembourg aims to be well positioned in this competition. The current "digital" ranking of Luxembourg is presented below, both from global and European Union perspectives.

European Innovation Scoreboard

Luxembourg is ranked 8th place in the European Union in the 2017 edition of the European Innovation Scoreboard[6], up from 9th position in 2016. Luxembourg is characterised as a strong innovator within the EU group of member states comprising Austria, Belgium, France, Ireland and Slovenia.

International Chamber of Commerce (ICC) Open Market Index 2017

The ICC's new Open Markets Index[7] scores 75 countries on a scale of one to six on four key factors: observed trade openness, trade policy, openness to foreign direct investment and trade-enabling infrastructure. In doing so, the Index also monitors government follow through on longstanding G20 commitments to boost global trade flows. Luxembourg ranks 3rd globally in the 2017 Open Market Index and is 1st in Europe.

Global Talent Competitiveness Index (GTCI[8])

The Global Talent Competitiveness Index (GTCI) is an annual benchmarking report that measures the ability of countries to compete for talents. The report ranks 118 countries according to their ability to grow, attract and retain talent. Luxembourg ranks 7th in the 2017 Global Talent Competitiveness Index.

IMD World Digital Competitiveness Ranking 2017

The IMD World Digital Competitiveness ranking covers the same country sample (63 economies) as the IMD World Competitiveness ranking. However, this new ranking focuses on a country's ability to adopt and explore digital technologies leading to transformation in government practices, business models, and society in general. The IMD World Digital Competitiveness ranking therefore assesses the capabilities and readiness of the economy to undertake the process of digital transformation. In this maiden report, Luxembourg is ranked 20th globally and 8th in the European Union.

European Digital Economy and Society Index (DESI[9])

This index covers five digital dimensions: Connectivity, Human Capital/Digital skills, Use of Internet by citizens, Integration of Digital Technology by Businesses and, Digital Public Services. Luxembourg is ranked 5th in the European Digital Economy and Society Index (DESI) 2017. This represents a jump of two places from 7th in 2016.

6 *http://ec.europa.eu/growth/industry/innovation/facts-figures/scoreboards/*
7 *https://iccwbo.org/publication/icc-open-markets-index-2017/*
8 *https://www.insead.edu/news/2017-global-talent-competitiveness-index-davos*
9 *https://ec.europa.eu/digital-single-market/en/desi*

Digital Transformation Scoreboard 2017

The Digital Transformation Scoreboard[10] provides a European monitoring mechanism to examine key trends in digital transformation. It offers, for the first time in 2017, a unique insight into statistics and initiatives to support digital transformation, as well as reports on key industrial and technological opportunities, challenges and policy initiatives related to digital transformation.

The Digital Transformation Scoreboard uses an indicator-based monitoring of digital transformation. There are five enabler indicators: Digital infrastructures, Investment and access to finance, Supply and demand of digital skills, E-leadership and Entrepreneurial culture, along with two "output dimension" indicators; namely the digital transformation of traditional businesses and the creation of digital start-ups. In addition to the seven indices, a Digital Transformation Enablers' Index was developed through a linear combination of each one of the enabling conditions indices.

Luxembourg is ranked 6th place within the EU in the Digital Transformation Enablers' Index, and 21st and 17th respectively on output indicators for integration of digital technology and the ICT start-up environment.

2.3
Economic context

Luxembourg is the smallest EU Member State (apart from Malta) with a population of 591,000 inhabitants[11] (0.1% of total EU population, 2017) and an area of 2,586 km^2. Luxembourg's GDP per capita is the second highest in the world at €90,000. Luxembourg posted real GDP growth in volume of 4.2% in 2016. Medium-term macroeconomic forecasts call for growth in volume of up to 4.4% in 2017 and up to 5.2% in 2018, with medium-term growth around 2.9% on average yearly for the 2019-2021 period.

Luxembourg's economy is dominated by the services sector, which contributes to 88.6% of GDP (2015). Industry makes up 11.3% of GDP, while agriculture is 0.3%. The services sector has evolved from 43% of GDP in 1970 to 85.2% in 1997 to 86% in 2013, which is the highest in the world after Hong Kong. The services sector itself is dominated by the financial services industry, which contributes more than 38% of GDP. When support services such as ICT, printing, etc. are included, its influence is even greater. As is true of the EU as a whole, Luxembourg is dominated by "Micro" businesses of 9 persons or less. It is interesting to note that despite making up 86.9% of all companies, micro firms contribute to only 21.8% of value added. Small and medium companies account for 46% of value added, while large companies account for 32.1%, although being only 0.5% of total firms. Nevertheless, SMEs play a critical role in Luxembourg's "non-financial business economy" generating in that case 72% of its value added and more than two thirds of total employment.

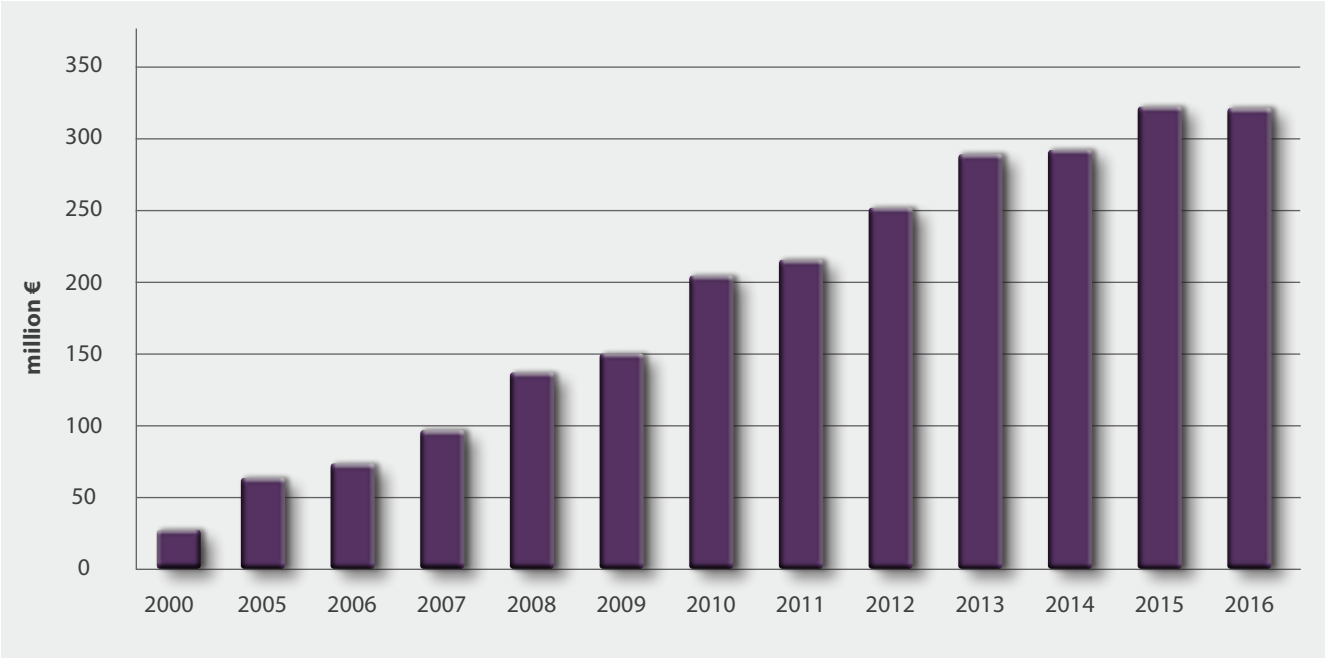
10 *http://ec.europa.eu/DocsRoom/documents/21501*

11 *STATEC Luxembourg*

2.4
Research and innovation landscape

R&D investment in Luxembourg at 1.3% of GDP in 2015 was weak in comparison to the EU average of 2%. The decrease in R&D expenditures by companies over recent years is in strong contrast with the intensity of public R&D comprising the public sector and higher education, which has grown continuously over the past fifteen years.

The increase in state spending (see Graph 2.4) on research and development increased from €28 million in 2000[12] (corresponding to 0.12% of GDP) to €321 million in 2015 (some 0.66% of GDP). This positive trend in budgetary allocations demonstrate the Government's willingness to invest in RDI and is the result of policies implemented over several years to support the continuing diversification strategy of the country.



Graph 2.4: State expenditure in R&D in the public sector

This state spending for public research activities in Luxembourg has been channelled to-date, primarily through institutional funding by the ministry of Higher Education and Research. The competitive part of the state spending is managed by the Luxembourg National Research Fund (FNR) agency. The FNR invests both public funds and private donations into research projects in various branches of science and the humanities. Its mission is to set up a sustainable world-class research system in Luxembourg that will generate societal and economic impact in key strategic areas and as such, focuses on the three strategic objectives to foster research with impact: Attaining scientific leadership in key areas; Turning public research into a competitive advantage for Luxembourg and, anchoring science and research in society.

[12] *STATEC Luxembourg*

A clear result of this continued public research support has been the rising R&D staff levels in the Luxembourg public sector that have increased from 531 full-time equivalents (FTE) in 2005 to 1562 FTEs in 2015[13] as detailed in the table below:

SECTOR	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
entreprises	1696	1460	1522	1453	1371	1460	1518	927	1001	1015	977	946
public sector (incl. higher education)	531	595	679	745	1025	1153	1313	1384	1502	1614	1562	1559
TOTAL	2227	2054	2201	2198	2396	2613	2831	2310	2504	2629	2539	2505

Table 2.4: R&D staff in full time equivalents

This trend has also been reflected in the emergence of strong public centres of research excellence in key strategic fields providing support to enterprises including cyber-security (University of Luxembourg's Interdisciplinary Centre for Security, Reliability and Trust, SnT[14]), systems biomedicine (University of Luxembourg's Centre for Systems Biomedicine, LCSB[15]) and broader enabling science and technology (Luxembourg Institute for Science and Technology, LIST[16]).

Luxembourg has also made a firm commitment to participation in international research organisations and platforms including the European Research Agency (ESA), the European Molecular Biology Laboratory (EMBL) and The Partnership for Advanced Computing in Europe (PRACE[17]), an international non-profit association, whose research infrastructure provides a world-class high performance computing (HPC) service for Luxembourg scientists and researchers.

[13] *STATEC Luxembourg: Table D8103, Number of full time equivalent staff in R&D 2005-2016*

[14] *The SnT is a dynamic interdisciplinary research environment with some 260 people. It conducts internationally competitive research to establish Luxembourg as a European centre of excellence for secure, reliable, and trustworthy ICT systems and services. https://wwwfr.uni.lu/snt*

[15] *The LCSB develops and applies systems-level approaches to gain insight into the molecular and cellular mechanisms of human diseases. The LCSB is pioneering the way for a predictive, preventive and personalised medicine. https://wwwfr.uni.lu/lcsb/research*

[16] *The LIST is a mission-driven Research and Technology Organisation (RTO). With its 630 employee, it is active in the fields of materials, environment and IT. It is under the trusteeship of the Ministry of Higher Education and Research. https://www.list.lu/*

[17] *PRACE is established as an international not-for-profit association (aisbl) with its seat in Brussels. It is named 'Partnership for Advanced Computing in Europe AISBL' with 25 member countries (see here): Belgium, Bulgaria, Cyprus, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Ireland, Israel, Italy, Luxemburg, The Netherlands, Norway, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom. The computer systems and their operations accessible through PRACE are provided by 5 PRACE members (BSC representing Spain, CINECA representing Italy, CSCS representing Switzerland, GCS representing Germany and GENCI representing France). http://www.prace-ri.eu/*

2.5 Outlook

With regard to an analysis of RDI trends in the private sector, as noted by the European Commission in its recent 2016 country report for Luxembourg[18], the relatively weak level of R&D expenditure by companies may be at least partly due to the presence of a major financial sector in Luxembourg (representing 38% of GDP) and the low level of investment intensity that characterizes such activities. It is therefore useful for Luxembourg, more so than for other countries, to analyse the principal R&D indicators in greater detail by branch of economic activity.

R&D intensity as a percentage of gross added value was at 7.3% in 2013 in industrial activities in Luxembourg[19], as in Belgium, and in a respectable position behind the Scandinavian countries and Germany, between 8.2% and 11.6%. With a low level of R&D intensity in non-financial services at 0.6%, Luxembourg is comparable to Germany at 0.9% and Malta at 0.6%. In financial services, Luxembourg performs less well with 0.1%, like the majority of other countries that were compared and which also feature low R&D intensity in this branch of the economy, with the exception of the Scandinavian countries, which range between 1.6 and 4.0%.

The implementation of an effective RDI policy for both the public and private sectors is a priority for the Luxembourg government. The government has set a range of between 2.3% to 2.6% of GDP (0.7% - 0.9% for the public sector) as a national objective for R&D intensity for the year 2020, although it seems already today very challenging to achieve such objectives within the foreseen timetable.

No individual ranking (IMD, WEF, European Union …) presented in this chapter should be seen as the ultimate and definitive ranking of any country with respect to research, innovation and economic competitiveness, particularly within a place-based strengths context. However, they inform and allow for observation of trends.

A specific picture of the Luxembourgish economy and innovation ecosystem emerges from the above global and digital benchmarking, that of an economy and innovation ecosystem that is globally and increasingly competitive.

The IMD World Competitiveness Ranking places Luxembourg in 8th place globally. The Global Innovation Index places Luxembourg 12th globally and 8th in the European Union. This is very coherent with the European Union's own innovation ranking which places Luxembourg also in 8th place, using quite distinct and different methodologies. Innovation is intimately linked to talent availability and therefore, it is comforting that Luxembourg ranks 7th in the Global Talent Competitiveness index 2017.

With respect to digital competitiveness, Luxembourg was ranked 20th globally and 8th in the European Union in the inaugural IMD World Digital Competitiveness Ranking 2017. However, the Luxembourg performance in each of the three Digital Competitiveness Factors: Knowledge, Technology and Future Readiness varies significantly and is revealing with respect to strengths and weaknesses. Luxembourg was ranked 27th in Digital Knowledge (talent, training & education, scientific concentration), 12th in Technology (Regulatory framework, Capital and Technological framework) and 23rd in Future readiness (adaptive attitudes, business agility and IT integration).

[18] *https://ec.europa.eu/info/publications/2017-european-semester-country-reports_en*
[19] *STATEC Luxembourg*

This IMD world digital competitiveness landscape is also consistent with the European Union specific digital picture painted by the European Digital Economy and Society Index (DESI) ranking which places Luxembourg 5th in the EU. Once again, an analysis of the five indicators within the composite EU digital economy index is informative. Luxembourg is one of the leading countries for connectivity (ranked 2nd in the EU, and up from 3rd place in 2016), digital skills (ranked 2nd in the EU, both in 2017 and in 2016) and Internet usage (ranked 3rd in the EU, and up from 4th place in 2016). However, with respect to the integration of digital technologies by companies (is only ranked 22nd in the EU) and digital public services (is ranked 19th in the EU, up from 21st place in 2016) there are relative weaknesses.

The IMD world digital competitiveness and European Union DESI index scores, positioning Luxembourg 8th and 5th respectively in the EU are consistent with the European Union Digital Transformation Scoreboard 2017, which ranks Luxembourg 6th place in the EU in the Digital Transformation Enablers' Index and 21st and 17th respectively on the integration of digital technology and ICT start-up environment output indicators.

In summary, Luxembourg provides high quality digital infrastructure, and is well positioned with a very favourable investment environment, and a positive supply and demand of digital skills. The main weaknesses lie in the low level of ICT start-ups and integration of digital technology (see 2.2).

3 SMART SPECIALISATION VISION AND PRIORITIES

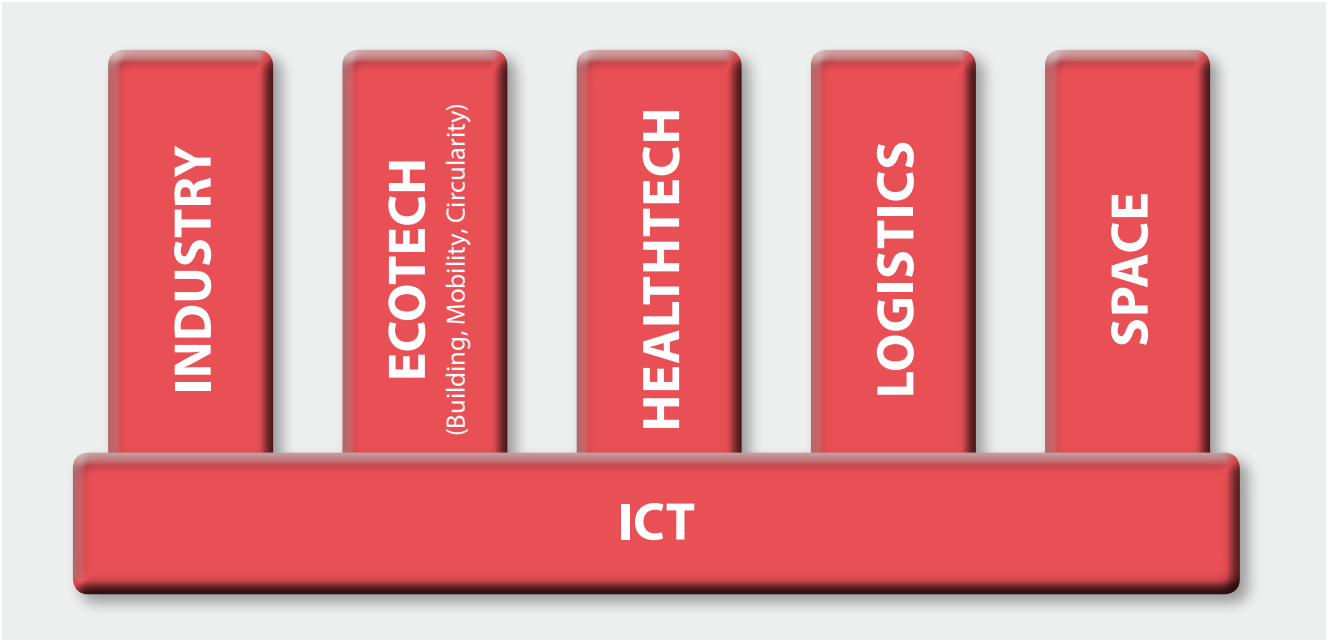
3.1 National economic priority sectors

The Luxembourg RIS3 is firmly rooted within the broad economic context described in chapter 2 and addresses key challenges identified, namely the diversification and digitalisation of the economy.

The Luxembourg government programme established in 2013 set out an active policy in the face of rapid global change to develop and diversify alongside the financial sector the fabric of the economy according to a "multi-specialisation" strategy. It focused diversification efforts on a small number of specific sectors to achieve critical mass and impact.

The government programme 2013 identified six priority sectors in the domain of economy and communications: Industry, Ecotechnologies (including building, Mobility and Circularity), Healthtechnologies, Logistics, ICT and Space.

The following schematic represents the highlighted priority sectors:



Schematic 3.1: Identified priority economic sectors 2013

3.1.1 Industry

In the previous century, Luxembourg was a global leader in the production of iron and steel, and an engineering and technology base for the non-ferrous products sector as well as for the glass and cement industry. It leveraged this heritage to both stimulate and attract leading materials based manufacturing companies such as ArcelorMittal, DuPont de Nemours, Goodyear, IEE, Euro-Composites, Ceratizit, Guardian Glass and Avery Dennison. Today composites, multifunctional materials and highly customised production technologies are at the heart of Luxembourg's manufacturing sector. With 32,200 employees, the sector represents 8.3% of total national employment. The Luxembourg Materials & Manufactoring Cluster provides support to the industrial members.

The government programme 2013 intended to have a strong, competitive and diversified industrial sector developing employment through an industrial policy based on research & innovation, the exploitation of intellectual property, access to international capital markets and a competitive economic environment. The subsequent creation of the Luxembourg High Committee for the support, development and promotion of industry in 2013 was a signal of the determination to support and grow the sector.

The forthcoming digitalisation of industry represents a new opportunity for the Luxembourg industry sector to reposition itself to be globally competitive. This new industrial revolution driven by new-generation digital technologies such as the Internet of Things, High Performance Computing, cloud computing, big data, robotics, artificial intelligence and 3D printing, amongst others will open up new horizons. The change of paradigm will have a profound impact on products, processes and business models in every sub-sector of Luxembourg industry. Already Luxembourg companies are positioning in this new digital world. For example, Goodyear, a tyre manufacturer has developed a new service business offering around the monitoring and monetization of digital data from tyres for predictive maintenance of freight vehicles. Guala Closures, a manufacturer of bottle closures, has introduced an "internet of closures" smart device new product. FEDIL, the business federation Luxembourg (Fédération des Industriels Luxembourgeois) has launched the D4I Digital for Industry initiative to stimulate Industry 4.0 across all industrial sectors in Luxembourg.

The Ministry of Economy is supporting the digitisation of Luxembourgish industry at several levels:

- Investments in digital computing infrastructure / High Performance Computing capacity and capability
- Development of a "trusted" world-class cloud and data infrastructure that will provide Luxembourg companies with wide computing and data analytics capacity
- Supporting digitisation pilots at national and European level (for example collaboration on "HPC and Big Data enabled Testbeds)
- Addressing new regulatory challenges arising from digitisation of the industrial fabric (e.g. the issues relating to data generated by the multitude of new smart products, liability of autonomous systems …)

3.1.2 Ecotechnologies

At a worldwide level Ecotechnologies are becoming increasingly important. The demand for products, processes and services with an environmental footprint will increase significantly. Luxembourg is committed to implement a circular and green economy under the Rifkin plan and is a signatory to the COP21 and COP22 to reduce CO^2 emissions. Luxembourg is committed to passive housing constructions and is promoting and setting up smart mobility solutions and intelligent energy grids.

Besides the circular economy, important subsectors are the energy efficiency, renewable energy and storage as well as sustainable water and waste management with a special focus on the construction and the wood sector. The building sector has a special position and Luxembourg is the first "triple A" construction country since January 2017.

Luxembourg particularly develops the automotive and mobility sectors and strengthens its position as a technology hub for connected, automated and coordinated driving. Luxembourg's strong ICT eco-system with proven competences in cyber security, data management and storage, high-speed connectivity with ultra-low latency to all major European hubs is a strong asset. In 2017 Luxembourg, France and Germany signed an agreement on a cross border test bed for automated and connected driving.

Luxembourg is the ideal platform for diffusing in Europe clean technologies from countries located more on the border of the European territory. Luxembourg aims to be at the forefront of sustainable development within the circular economy principle.

3.1.3 Healthtechnologies

Through its "Science & Health Technologies Action Plan", Luxembourg made the strategic choice in 2008 to build on the strong potential of biomedicine in terms of industrial development to diversify its economy. Key investments in its public research have provided a foundation of expertise and knowledge in molecular diagnostics and related areas that can support the transition from curative medicine to preventive and personalized medicine at the national level. Faced with the challenges posed by the aging of populations observed in all industrialized countries, including Luxembourg, this transition appears to be the best compromise to reconcile sustainably excellence of quality of life and quality of healthcare for all, while controlling the costs of healthcare systems.

The societal impact of this initiative is already observed at the medical level in Luxembourg where the public biomedical research actors, namely IBBL[20], LCSB[21], LIH[22], LNS[23] and LSRU[24], bring in their wake hospital institutions in order to facilitate the access of patients to innovative therapeutic or diagnostic solutions. The economic translation of the research results generated by these public centres of expertise and knowledge begins gradually, manifesting itself through patent filings, licensing agreements, public-private partnerships and start-up creation. However, the macroeconomic impact of this initiative in terms of substance and value generated on the Luxembourg territory (e.g. company creation, investment, turnover, job creation) has still to come.

In this context, the field of digital health, whose growing market is a major source of value creation and employment globally, has been identified as a strategic opportunity for the development of the Health Technologies sector in Luxembourg. Digital

[20] *Integrated Biobank of Luxembourg*
[21] *Luxembourg Centre for Systems Biomedicine (University of Luxembourg)*
[22] *Luxembourg Institute of Health*
[23] *Laboratoire National de la Santé*
[24] *Life Science Research Unit (University of Luxembourg)*

health technologies are already currently reshaping biotech, pharma and medical device industries through: (1) the increasing use of big data analytics in personalized medicine; (2) the stronger interest for value-based medicine and cloud-based analytics; (3) the increasing adoption of patient registries; (4) the growing desire of consumers to use wireless wearable monitoring devices and (5) the stronger influence of digital media in healthcare.

With the objective to accelerate the transition from a research-driven to a business-driven biomedical ecosystem in Luxembourg, it is proposed to capitalize both on the strengths of the Luxembourg ICT sector and existing biomedical public research expertise to foster the development of a critical mass of companies active in the fast growing areas of mobile health and big data analytics, two of the four main technology segments that compose the digital health industry.

3.1.4 Logistics

Over the past decade, Luxembourg has continuously improved its positioning as an intercontinental and multimodal logistics hub in Europe for value-added logistics activities. In synergy with the other key economic sectors, a multi-product specialization strategy has been implemented within the logistics sector in order to develop tailor made logistics solutions for certain types of products that require specific handling and/or storage solutions such as pharmaceuticals, high valuables or parcels delivery generated from cross-border e-commerce sales.

If globalization has largely influenced the logistics sector over the last decades, new drivers, such as digitalisation and new technologies, are expected to disrupt and reshape global supply chain networks and their related logistics business models. Digitalisation is already boosting cross-border e-commerce sales around the world, and as a result, it is transforming retail distribution channels and delivery services. Further, new technologies, such as 3D printing, Internet of Things (IoT), Blockchain, Robotics and Artificial Intelligence are, among other technologies, expected to reshape logistics processes along the entire logistics value chain from warehouse management to end-to-end traceability and last-mile delivery. Finally, the interactions among the numerous partners involved in global supply chains generate an endless amount of data that need to be efficiently handled in order to turn them into smart data. Therefore, Big Data and predictive analytics also represent a huge potential for the logistics and supply chain sector, especially in terms of process efficiency, demand forecasting and inventory management.

In today's digital era, the logistics sector is expected to experience a deep transformation where logistics incumbents will be challenged by new innovative logistics start-ups that could be seen either as new competitors or as strategic partners. In order to en-

sure a sustainable growth of Luxembourg's logistics sector, it is thus needed to investigate the role of new disruptive technologies and, if possible, identify, with the other "smart" sector's leaders, common disruptive technologies to focus on. Based on this analysis, it will be then opportune to leverage on Luxembourg's ICT and start-up ecosystem in order to stimulate innovation and digital start-ups activities within the Luxembourg logistics sector.

In parallel, Luxembourg needs to further increase administrative process efficiency by implementing a full paperless environment through the realization a Single Window for Logistics.

3.1.5 Space

The space industry is a key high-tech domain for Luxembourg. SES, one of the world's leading media and telecommunications group, was established in Luxembourg in 1985 to provide pioneering satellite-based communication services. Luxembourg today is home to over 30 highly-advanced technology companies and eight public research laboratories involved in space-related research in close partnership with the local industry.

The second major step in positioning the country in the space sector was Luxembourg's accession to the European Space Agency (ESA). After a first co-operation agreement on the telecommunications programme ARTES, Luxembourg became ESA's 17th Member State in June 2005.

In line with its determination to create a solid and innovative space sector, Luxembourg has developed a comprehensive space policy with four major objectives:

- Contribute to the diversification and sustainability of economic activities in Luxembourg
- Consolidate and enhance existing skills in the field of telecommunications and media as well as ground systems
- Extend skills in the sector
- Give an international dimension to the activities through an access to international networks

Achieving the objectives of the national space policy requires the implementation of several measures at European and national levels. Over the last 30 years,

the country has firmly supported the industry, providing a combination of policy, programs and funding targeted squarely at encouraging innovation and entrepreneurship. Government spending on the sector currently amounts to 0.03% of GDP, ranking the country in ESA's top five in per capita terms.

Luxembourg contributes to various ESA programmes, not only on areas of historical interest for Luxembourg, such as telecommunications, but also in the areas of Earth Observation, Navigation, Technology and Security. The Government has also developed bi- or multi-lateral cooperation with other major space actors outside Luxembourg, such as CNES, DLR and NASA.

On a national level, the Government has put in place several programmes to support its space sector. The LuxIMPULSE programme, a programme managed by ESA, helps companies investigate innovative ideas and develop them into products. LuxYGT, designed to provide the space sector with a new generation of experts, offers training to young graduates in space-related technologies. The programme includes the opportunity for a participant to conduct a specific project under the guidance of an ESA staff member.

More recently, Luxembourg government took a further step towards diversifying the space sector. The Government announced a series of measures to position Luxembourg as a European hub in the exploration and use of space resources:

- Amongst the key steps undertaken, as part of the spaceresources.lu initiative, is the development of a legal and regulatory framework confirming certainty about the future ownership of minerals extracted in space from Near Earth Objects (NEO's) such as asteroids. Luxembourg is the first European country to set out a formal legal framework which ensures that private operators working in space can be confident about their rights to the resources they extract, i.e. rare minerals from asteroids.
- Luxembourg will also invest in relevant R&D projects and consider direct capital investment in companies active in this field.
- A further step in developing the space sector will be the creation of a Luxembourg space agency fund, which will enable private space industry investment.

3.1.6
Information and communication technologies

Since the beginning of the years 2000, Luxembourg has identified the importance of ICT for the successful diversification of the country's economy. Major infrastructure investments have been carried out to develop extensive broadband networks ensuring international connectivity and to build state of the art high-end data-centres. In parallel, interdisciplinary public research centres such as SnT or LCSB, heavily relying on ICT capabilities and expertise, have been created to foster academic excellence in this field. These initiatives together with a growing start-up ecosystem and a strong economic fabric of major industry players such as RTL Group , SES, Amazon, eBay, Rakuten or Vodafone make Luxembourg standing on solid foundations to face the opportunities and challenges arising from a digital interconnected future.

Luxembourg believes that future opportunities in ICT lie in building a connected and efficient Data Driven Economy. Data is a key transversal asset for developing new services in fields such as industry 4.0, fintech, autonomous driving, connected logistics, digital health, space technologies and increasingly becoming a primary driver of growth and efficiency across all sectors identified as priorities for Luxembourg's diversification strategy.

Data is therefore a critical component of digitalisation and Luxembourg intends to support the development of enterprises and research centres active in the entire data value chain, from collection to transfer, secure storage, curation, analysis and visualization of data across the identified key sectors.

In order to enable a faster growth of the Data Drive Economy in Luxembourg, it will be essential to support the enabling technologies and infrastructures such as IoT, Blockchain or Big Data, Cybersecurity or HPC, with significant implications in terms of regulatory frameworks and public investments foreseen in the upcoming years.

To further drive innovation in this field, Luxembourg has the objective to become a reference "Test-Bed" location for corporates and start-ups wanting to test their new data powered products and services.

3.2 Vision for Luxembourg 2030: a toolbox for reflection on a smart specialisation strategy

Building on the 2013 Programme for Government, the Ministry of the Economy, the Chamber of Commerce and IMS Luxembourg initiated a deep collaborative initiative over 18 months that culminated in a vision, narrative and game plan to usher in a smart green digital society.

The strategy study, entitled the Third Industrial Revolution, encompassed the combined inputs of over 300 national stakeholders and working groups from all facets of Luxembourg society, facilitated by the Rifkin TIR Consulting Group. In fact, the government took on a new role as a facilitator of the process replacing top-down governance with a peer approach, engaging a broad representative swath of the national community.

In line with best practices in formulation of Smart Specialisation strategies, the study was conducted using a bottom-up approach, actively involving national stake-holders who combined their know-how, ideas, views, experiences and visions in order to bring multiple perspectives into the process. In tandem with country-specific macroeconomic data, this unprecedented collaboration resulted in a tailor made study adapted to local realities. In other words, a place-based smart specialisation strategic framework.

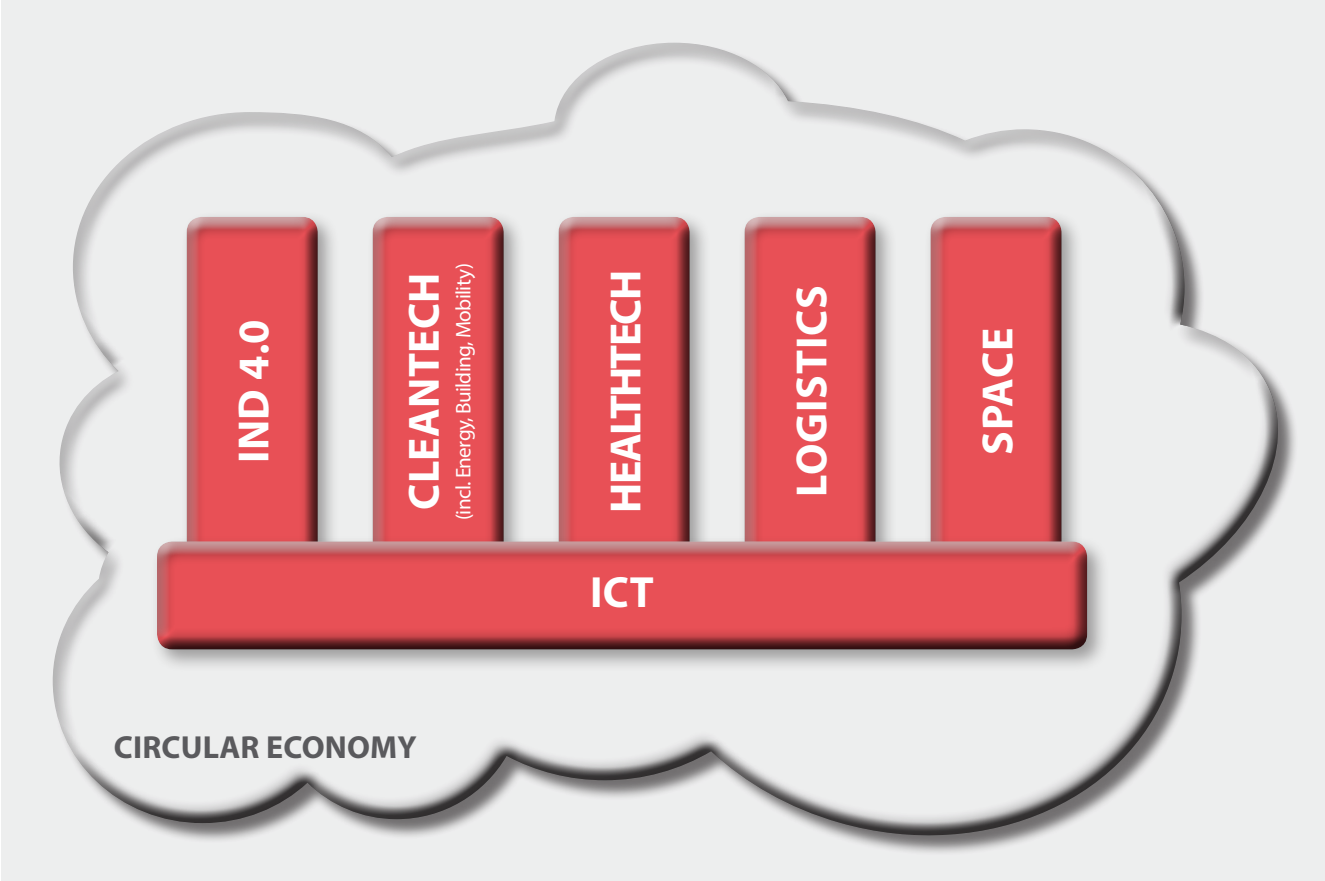
The study, broke additional ground by taking a cross-disciplinary approach to the future development of Luxembourg, combining social, cultural and environmental narratives, economic theory and business practices, with the goal of reconceiving economic development within a larger frame of "quality of life".

The deployment of the Third Industrial Revolution strategy aims to position Luxembourg as a flagship nation in the European Union build-out and scale up of a smart digital society, supporting the Europe-an dream of a borderless digital infrastructure and integrated single market

A major aim of the study was to raise awareness and prepare Luxembourg's economy and society for the upcoming megatrends and inherent disruptive forces, notably digitalisation, automation, decarbonisation and efficient resource use as well as for new economic models, including the circular economy and the sharing economy. Whilst Luxembourg is not the driver of these worldwide megatrends, it is essential that the country anticipates the changes and takes preventive action to ensure the nation's future competitiveness. The strategic study therefore provides a toolbox containing instruments to prepare for the future.

The different working groups have enriched immensely the reflections on the specific Luxembourg Smart Specialisation Strategy by identifying and discussing related economy opportunities, challenges and trends, and by proposing strategic measures and concrete actions in different areas including infrastructure, technology, regulatory framework, policies, new business models, finance and education. The study serves to guide socio-economic actors on the way forward.

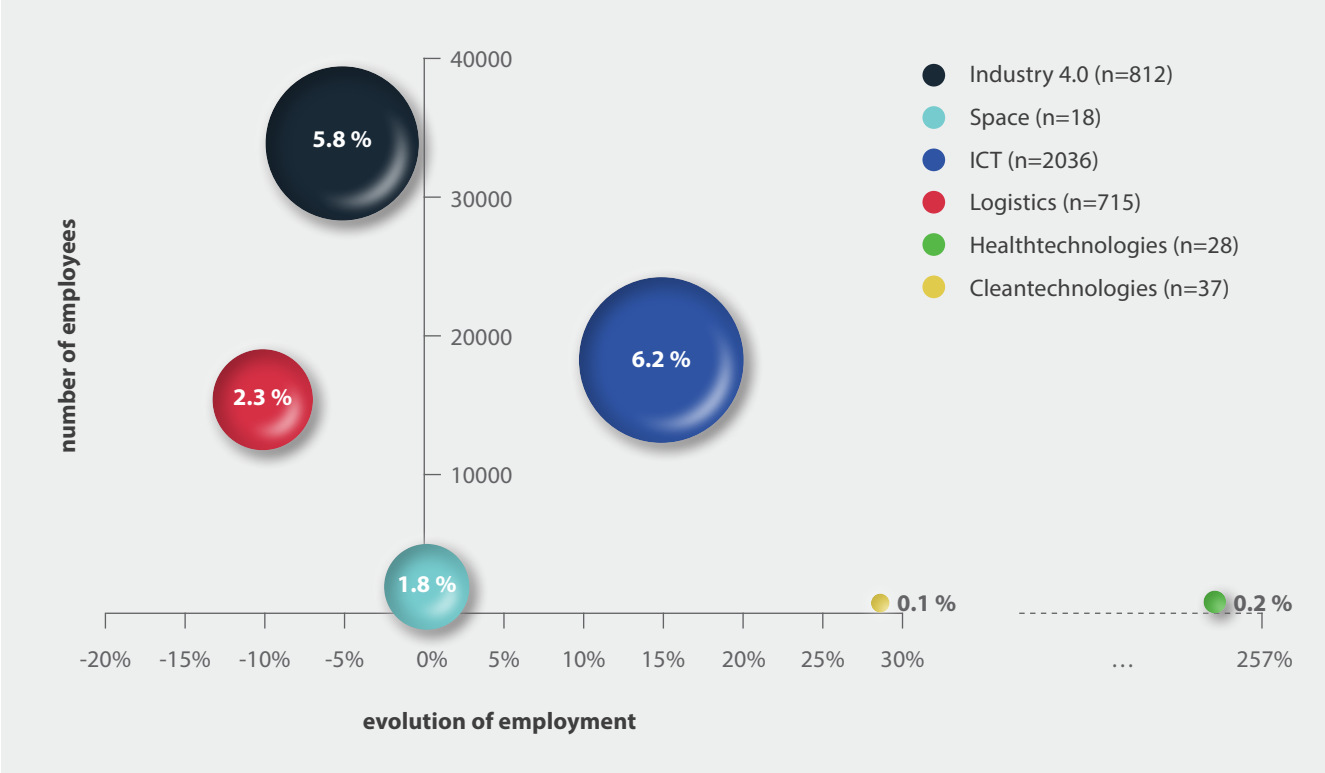
One outcome from the study has been a subtle reframing of key economic priority sectors, with six key sectors operating within a circular economy perspective:



Schematic 3.2: Reframed key economic sectors 2017

3.3
Smart specialisation priority sectors

The smart specialisation prioritisation process was based on input from the Third Industrial Revolution study, as discussed above, and an analysis of the importance of the different economic sectors on employment, added value and number of enterprises. A summary of the result of this analysis detailing the economic impact of the different national economic priority sectors is presented pictorially below.



Graph 3.3: Impact analysis of the Ministry of the Economy priority sectors on employment and gross added value

Note: *n= number of entreprises in 2014*
The evolution of employment is calculated between 2008 and 2014
The size of the bubble with the percentage represents the part of the sector in the national economie in terms of added value in 2014

Sources: *Rapport de compétitivité 2017, http://www.gouvernement.lu/4263741/publications and STATEC Luxembourg, Manufacturing Industry (NACELUX Rév. 2 Section C)*

One may note that the fastest growing sectors in terms of employment are those of ICT, Cleantech and Healthtech.

The employment between 2008 and 2014 grew by 28% in the Cleantech sector and by a staggering 257% in the Healthtech sector. In 2014 these two sectors employed each around 600 persons. In 2014, the Clean-

tech sector represented 0.1% and the Healthtech sector some 0.2% of the national gross added value.

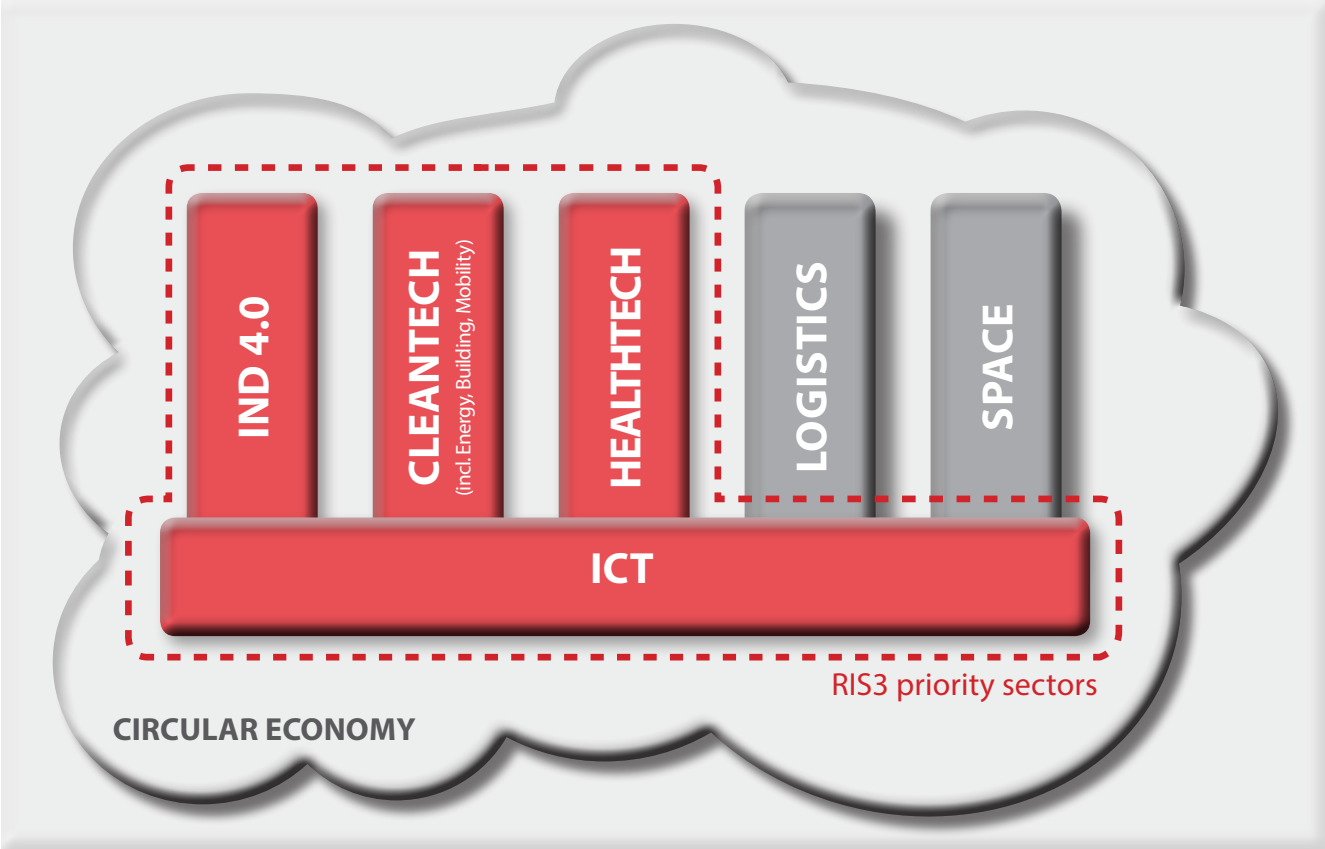
The ICT sector has some 16,000 employees and represented 6.2% of the gross added-value in 2014.

The logistic sector's employment has decreased by some 10% from 2008 to 2014, which is however, a consequence of the ongoing reorientation of the logistic sector from the labour-intensive freight business to activities with more added value.

The Space sector represents almost 2% of the national gross added value with 600 employees. This sector benefits from targeted policy instruments.

To maximize the impact of the ERDF funds the final selection of smart specialisation priority sectors comprises Industry 4.0, Cleantech, Healthtech and ICT. The first three are fast growing sectors where innovation is a priority. The choice of Industry 4.0 reflects the urgent need to accelerate the digitalisation of industry highlighted in both the European Commission Digital Economy and Society Index (DESI) benchmarking and the IMD world digital competitiveness report.

The following schematic shows the four selected smart specialisation priority sectors:



Schematic 3.3: Smart specialisation priority sectors

4 SMART SPECIALISATION POLICY INSTRUMENTS

A wide range of programmes and policy delivery instruments are used to enable the Luxembourg industrial and innovation strategy. These include a policy mix of instruments to support knowledge generation, diffusion and exploitation in both the public and private sector and, specific instruments targeting SMEs.

4.1 Luxembourg innovation delivery instruments supporting knowledge generation, diffusion and exploitation

The Luxembourg innovation delivery instruments are designed to accompany the ongoing strengthening of existing high-tech industry STI capability and support the knowledge absorption and generation necessary for the diversification of the Luxembourg industrial tissue.

These instruments include:

R&D incentives

The innovation fund, created in 2009, provides direct R&D incentives[25] to support research and innovation:

- Research and Development projects and programmes
- Feasibility studies
- Innovation aid for SMEs
- Aid for young innovative enterprises
- Aid for process and organisational innovation
- Investment aid and support for research infrastructure and Innovation clusters

The aides can be grants or repayable advances for all instruments and for certain interest bonus, loans, guaranties or equity investments.

[25] *Incentive schemes of the modified law of 5 June 2009 to promote research, development and innovation, replaced by the law of 17 May 2017*

Support for STI talent *(mobility schemes, global talent attraction schemes, industry PhD schemes, …)*

- This support is provided via the Ministry of the Economy or the FNR.
- Of particular note, the FNR operates the prestigious PEARL programme to attract outstanding research professors to Luxembourg.

Special support for start-ups

- The Luxinnovation programme Fit4Start provides a support service for start-ups.

Support programmes for innovation and digitisation

- Fit4Innovation
- Fit4Digital
- Fit4Circularity

Public private research and innovation partnerships

- Specific FNR support schemes (AFR-PPP and CORE-PPP) has been established for Luxembourg public research performers to promote public private partnerships with Luxembourg industry.
- Furthermore, the innovation fund provides specific incentives for private sector companies entering into public private research and innovation partnerships.

Competence centres

- Centre de Ressources des Technologies pour l'Innovation dans le Bâtiment G.I.E. (CRTI-B)
- National Composite Centre – Luxembourg
- Cybersecurity Competence Centre Luxembourg (C3)
- Neobuild (innovation in the construction area)
- Additional competence centre to be established in the area of HPC and Big Data

Industry clusters

In 2017, the following clusters have been coordinated by the national innovation agency Luxinnovation:

- Automobility cluster
- Biohealth cluster
- Creative industries cluster
- Ecoinnovation cluster
- ICT cluster
- Materials & manufacturing cluster
- Space cluster
- Wood cluster

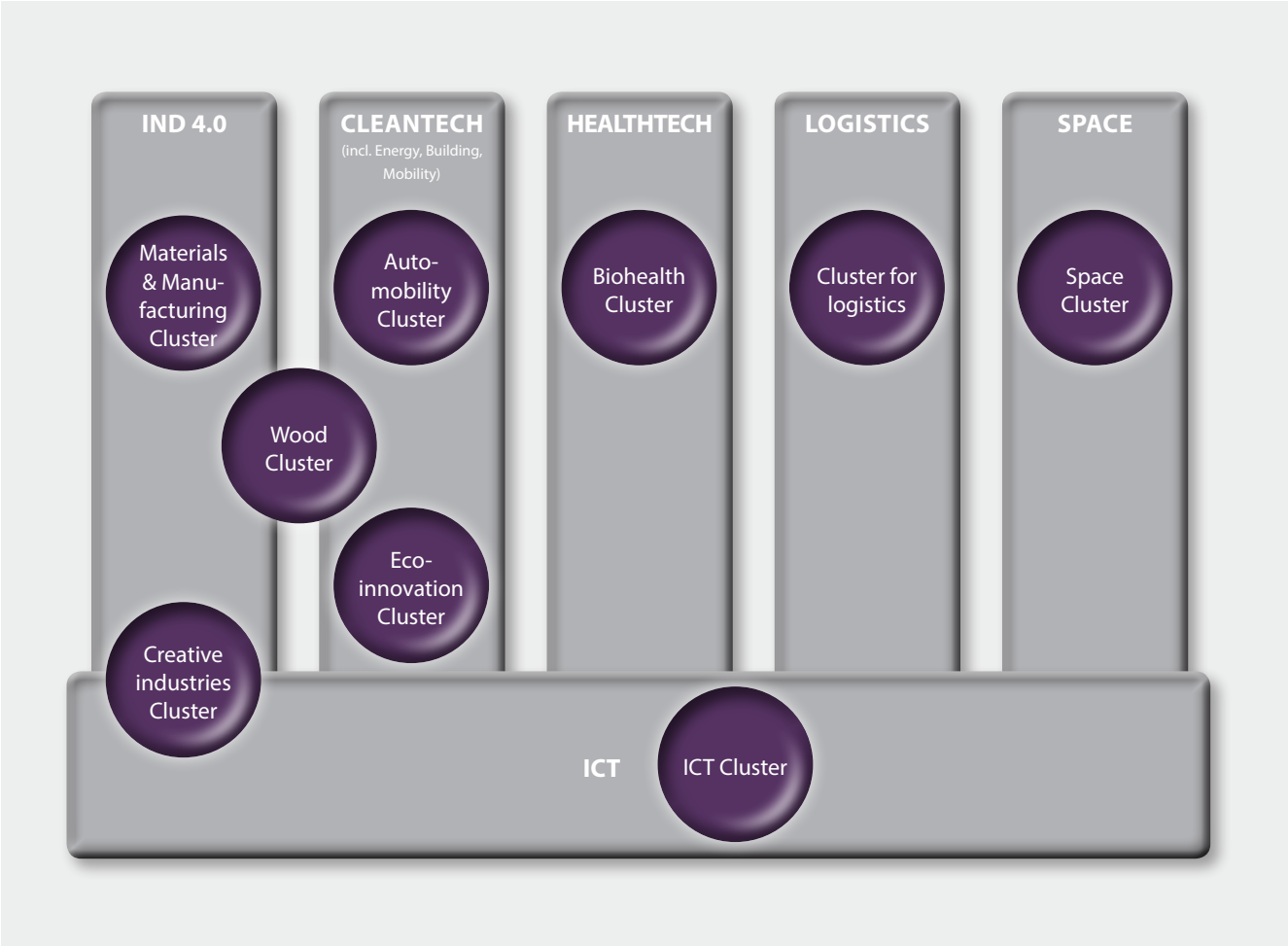
Two additional clusters are coordinated by relevant sectorial organisations:

- Maritime cluster
- Cluster for Logistics

These clusters are supported by the Luxembourg Innovation Fund via two instruments:

- Investment aid for innovation clusters (poles/hubs)
- Operational aid for clusters

The following schematic positions the industry clusters relative to the national economic priority sectors:



Schematic 4.1: Mapping of industry clusters to priority economic sectors

Incubators (including start-up support services, coaching, Fit4Business audit, …)

Luxembourg public and private sources support several incubators:

- Technoport
- Nyuko
- Lux Future Lab
- House of Biohealth
- Neobuild
- Luxembourg House of Fintech (LHoFT)
- 1535°C
- Innovation Hub Dudelange
- House of Start-ups
- Luxembourg City Incubator
- Paul Wurth InCub
- Tomorrow Street

Seed and venture capital funds

- Société Nationale de Crédit et d'Investissement (SNCI)
- Capital-Développement PME (CD-PME)
- Eurefi
- Digital Tech Fund
- Luxembourg Future Fund
- private funds: Mangrove Capital Partners, Expon Capital, …

Techno-economic intelligence schemes

- This service is provided by the national innovation agency Luxinnovation, supported by the Ministry of the Economy.

Support for participation in international competitive STI programmes (H2020, ESA, ….)

- H2020
- ESA

4.2
Ongoing policy experimentation and optimization

Recent examples of the ongoing experimentation and optimization of this policy mix, both through targeted and horizontal measures, during 2015 to 2017, include:

- In 2015, the government of Luxembourg launched the Digital4Education strategy, which aims to foster the development of IT skills among students and to ensure that they are well equipped to take full advantage of the ongoing digital transformation of society in everyday life and at work.

- Creation of the Luxembourg Future Fund in 2015. This €150 million fund was created to stimulate the diversification and sustainable development of the Luxembourgish economy. It was set up by the EIF and the Société Nationale de Crédit et d'Investissement (SNCI) and combines a €120 million contribution from SNCI with €30 million from the EIF, to be deployed over a five years period. It invests in early and growth innovative European technology SMEs as well as in venture capital funds.

- In 2016, the government of Luxembourg established the Digital Tech Fund to support the funding and development of ICT start-ups in the country. The Digital Tech Fund is a public-private partnership in which the State´s participation amounts to €5 million and is complemented with a €15.33 million financial contribution from private investors and other public actors such as the Société Nationale de Crédit et d'Investissement (SNCI) and the University of Luxembourg. The fund has a particular focus on venture capital investments in areas such as cybersecurity, FinTech, Big Data, the `Internet of Things´, etc.

- The creation of the Fit4Digital programme in 2016, to support SMEs that wish to utilize digital solutions in their company. Fit4Digital supports the digitalisation of small enterprises by assisting companies to identify concrete opportunities for using information and communication technologies (ICT) and then introduce new ICT tools in different fields: human resources, marketing, procurement and finance, and so on.

- The Industrial Partnership Block Grant (IPBG) programme was established in July 2016 to foster cooperation, by funding PhD's, between Luxembourg based companies active in R&D and Luxembourg public research institutions

- In March 2016, the 4th National action plan to support SMEs was adopted. The plan includes 99 measures focused on: the promotion of entrepreneurship and an entrepreneurial spirit, the adaptation of regulations to the evolution of the labour market, more accessible financing and the creation of a favourable environment for innovation and research.

- In 2017, the introduction of a new State aid regime on "Research Infrastructures". This regime allows the support of acquisition of shared research equipment. It allows Luxembourg to obtain state-of-the-art equipment, which will be typically shared between private and public research actors. It thus supports actors along the value chain.

- In 2017, a new Luxembourg Space innovation strategy within a legal framework for space exploration was established. Luxembourg thus becomes the first European country to set up a legal framework for space exploration and

the use of space resources. The law on space resources was passed on 13 July 2017. Luxembourg is thus the first European country to implement legislation giving private operators assurances regarding the ownership of the resources that they extract in space. It also regulates the approval and surveillance of missions to explore and use space resources. This legal framework is one of the main pillars of the Space strategy adopted by the government as part of the SpaceResources.lu initiative to develop the space exploration sector and the use of space resources.

4.3
Smart specialisation policy mix

The Luxembourg RIS3 strategy uses, in particular, one of the above innovation delivery instruments; namely R&D incentives to support public research projects in the RIS3 priority sectors. This comprises over 69% of the allocated financial support to date.

In parallel, support is provided to the Ministry of Economy by Luxinnovation, the national agency for research and innovation in charge of the promotion and stimulation of related innovation activities in the private sector.

The competence centres and clusters are also valuable supports for the projects in the RIS priority sectors.

The ERDF operational programme "Investment for Growth and Employment" for the period 2014-2020 was adopted by the European Commission on 15 December 2014. Based on the above policies and strategic priorities, several tenders for projects were launched in 2015, 2016 and 2017 respectively. 15 projects were selected up until July 2017, amounting to €31.7 million, with ERDF financing €12.7 million which may be divided into two axis as follows:

PRIORITY AXIS	Total cost mio €	ERDF co-financing mio €
Axis 1 "Improve research, technological development and innovation"	17.4	7.0
Axis 2 "Support the transition to a low carbon emissions economy in all sectors"	14.3	5.7
TOTAL	31.7	12.7

Table 4.3: Call for projects – projects chosen (up to July 2017). Source: Ministry of the Economy

SMART SPECIALISATION

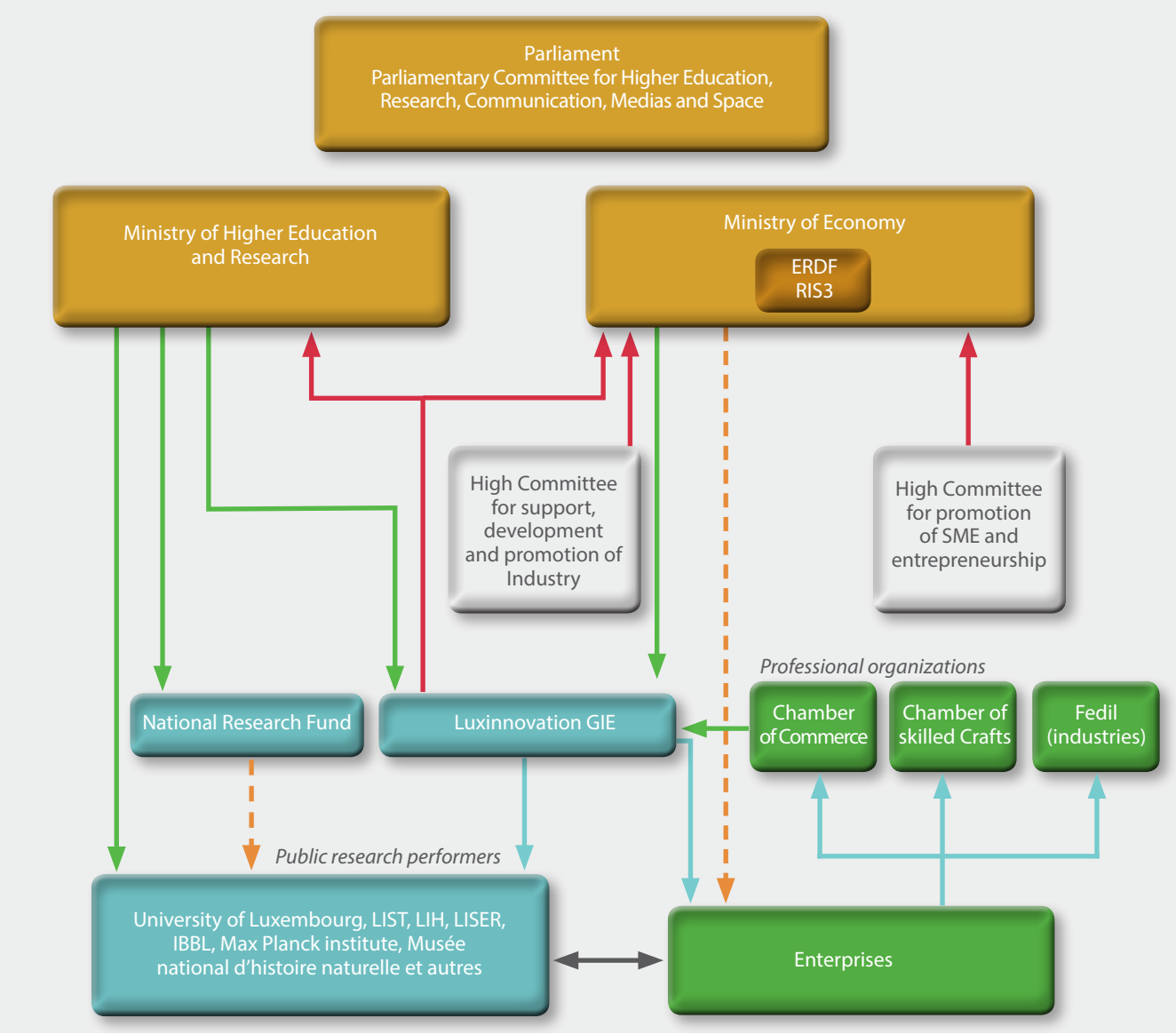
5 GOVERNANCE

5.1 National innovation governance landscape

In the framework of the Luxembourg S3, the formal authority resides within the Ministry of the Economy. However, the S3 governance is characterised by the interaction of several different instances of coordination and consultation that include the four principal actors of the Luxembourg innovation economy; namely government, industry, public research and education actors and, civil society.

Luxembourg has put in place a governance system that facilitates the management of the national research and innovation in a dynamic, multidisciplinary and holistic manner.

The Ministry of the Economy and the Ministry of Higher Education and Research are the primary actors concerned with the management of the research, development and innovation strategy of the country. The interactions between these ministries and other instances of decision are shown in the schematic below.:



Schematic 5.1: The National Research and Innovation Governance Landscape detailing the principal actors

- *Financing via Performance contracts*
- *Financial Instruments*
- *Support service*
- *Projects collaboration*
- *Public financing via project and program funding*
- *Advice*

The Luxembourg parliamentary commissions for economy and higher education, research, communication, media and space, follows the work of the government at the level of economic diversification and research and innovation. In its coordination and elaboration of priorities, the government uses different inter-ministerial platforms, which include representatives of the business world along with professional federations and business chambers. The two principal platforms in this regard are the High Committee for the Support, Development and Promotion of Industry and the High Committee for the Promotion of SMEs.

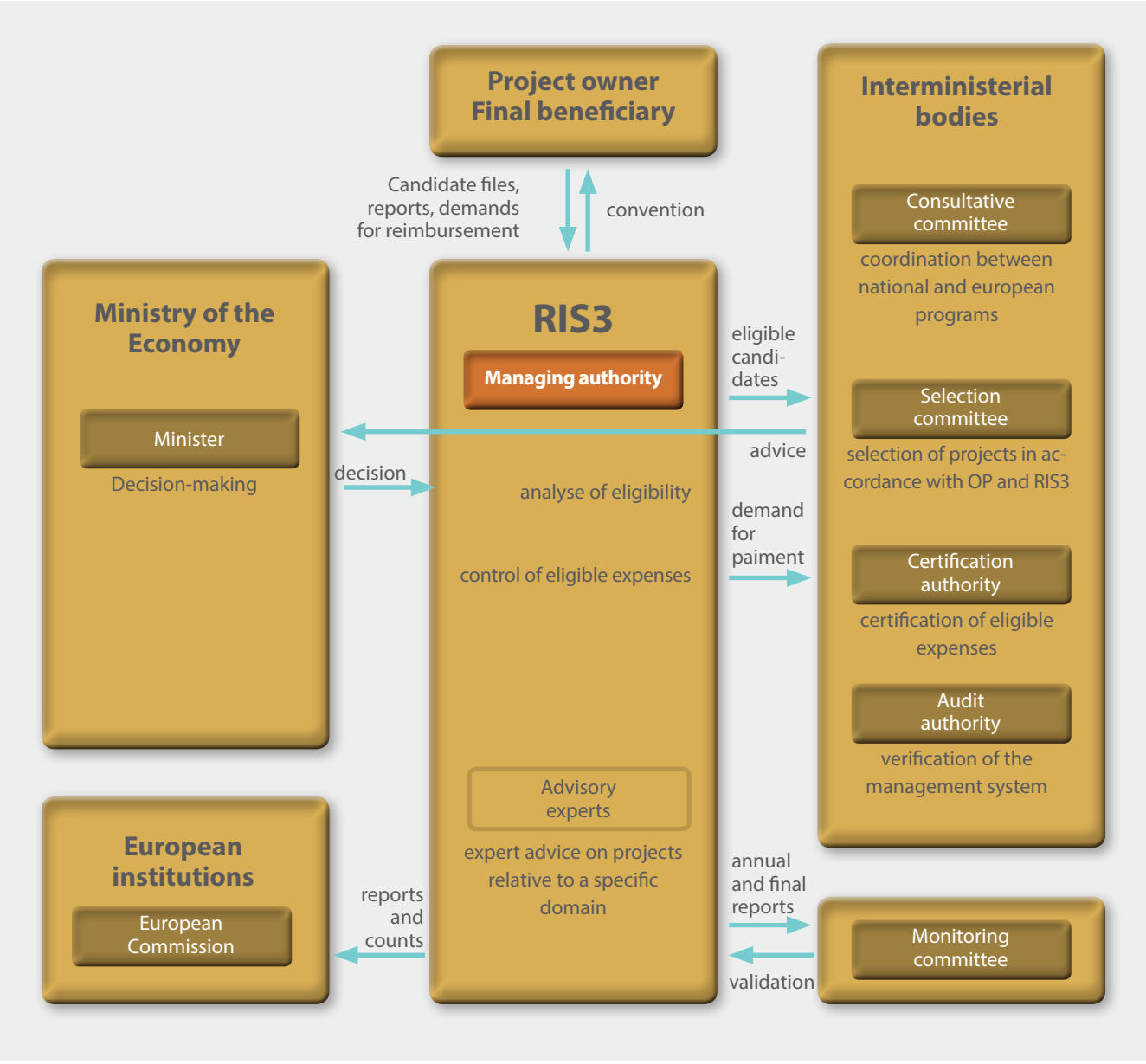
The High Committee for the support, development and promotion of industry has as mission to stimulate the industry sector. The Ministries of Economy and Finance established the committee in 2013. It is composed of members of government and experts from the world of industry. The committee can perform SWOT analyses of the Luxembourgish industry, formulate recommendations and action plans, propose new opportunities for industry and review national industrial policy in light of new industrial challenges that Luxembourg has to face.

The High Committee for the Promotion of SMEs was established in 2014. Its objective is to discuss and propose measures to stimulate entrepreneurship, company creation and stimulate the development of the SME sector. It is composed of representatives of the Chamber of Commerce, the Chamber of Skilled Crafts, the Federation of Artisans and the Confederation of Commerce. It is presided by the Minister of the Economy.

Regular performance evaluations of the public research actors and relevant government research and innovation agencies (FNR, Luxinnovation), linked to performance contracts, allow the relevant Luxembourg authorities to follow the execution of their research and innovation strategy, and to take any corrective action deemed necessary. The performance contracts facilitate the focusing of resources on key operational targets.

5.2
Smart specialisation governance structure

The Ministry of the Economy has primary responsibility for the development and execution of the European Regional Development Fund (ERDF) Luxembourg operational programme in conformity with relevant European regulations. The managing authority for the implementation of the Luxembourg RIS3 strategy lies within this ministry. The governance structure and decisional flow is shown schematically in the figure below:



Schematic 5.2: The smart specialisation governance structure

The consultative committee provides a forum to coordinate the development of strategies and priorities amongst the managing authorities of the ERDF programme in Luxembourg, the INTERREG funds, the European Social Funds (ESF) and the European Agricultural Fund for Rural Development (EAFRD). The coordinator of the committee is the ERDF managing authority in the Ministry of the Economy. The presence of the Ministry of Sustainable Development and Infrastructures, who is the competent authority for the management of the ERDF INTERREG programmes, assures the appropriate coordination of the broader Luxembourg strategy.

The selection committee has as mission, the selection of projects based on operational programme and S3 strategy criteria. It comprises representatives from government ministries and public research structures.

The certification authority comprises representatives of the Ministries for the Economy and Finance (financial controller). This authority systematically controls all expenses linked with the use of structural funds.

The audit authority assures operational financial control according to international audit standards and the ministry audit strategy. The audit authority issues an opinion on the annual accounts. Its reports are sent to the European Commission by the managing authority.

The monitoring committee has, as mission, to guarantee the efficiency and quality of the execution of the operational programme. It comprises representatives from Government ministries (in particular, the S3 Managing authority and all ministries directly concerned by the ERDF operational programme), Districts, Economic and social partners and, the European Commission.

The advisory experts have as mission, to provide advice on projects in a particular domain.

The RIS3 governance actors at the level of the ERDF funds regroup with those who elaborate the research and innovation priorities at the national level. By this means, a permanent exchange between the two levels is thus guaranteed.

In conclusion, the governance structure put in place allows the different actors to interact in such a manner as to allow a collaborative management of the RIS3 by the public authorities, enterprises, public research institutions and civil society.

6 MONITORING AND EVALUATION

6.1 External success indicators

The implementation of the RIS3 strategy is monitored continuously at both political and stakeholder levels. The strategy's success will be assessed regularly, on an annual basis, and communicated widely both at National and European level.

The results indicators for the RIS3 strategy cover both external context indicators along with national results and output indicators. The external indicators, such as The Global Innovation Index and the European Innovation Scoreboard, allow Luxembourg to compare against similar EU member states and internationally. A particular focus is placed on the Luxembourg positioning in the digital economy. The specific results and output indicators will comprise national growth and innovation indicators including the number of patent applications, the number of start-ups and the percentage increase in employment. The Ministry of the Economy is the designated ministry to monitor the RIS3 strategy implementation and impact.

In parallel with this ongoing monitoring of specific impacts of the RIS3 strategy, the RIS3 managing authority will also conduct a regular holistic self-assessment of progress using the RIS3 Assessment Wheel methodology. This will provide an immediate visual recognition of strengths and weaknesses, and facilitate benchmarking with other member states and regions.

The RIS3 monitoring and evaluation unit will pay particular attention to the following external global innovation indicators:

- Global Innovation Index 2017 Report
- European Innovation Scoreboard

In addition, a particular focus will be on the Luxembourg positioning in the digital economy using the following reference point indicators:

- European Digital Economy and Society Index (DESI)
- Digital Transformation Scoreboard 2017

6.2

National results and output success indicators

The selected results and output indicators include a mix of national growth and innovation indicators. Specific attention has been taken to use, where possible, commonly agreed European innovation output indicators[26] along with Luxembourg specific success indicators.

The four European innovation output indicators retained are:

- Technology innovation as measured by patents
- Employment in knowledge-intensive activities as a percentage of total employment
- Competitiveness of knowledge-intensive goods and services (based on the both the contribution of the trade balance of high-tech and medium-tech products to the total trade balance, and knowledge-intensive services as a share of the total services exports)
- Employment in fast-growing firms of innovative sectors

In addition, the following indictors will be monitored:

- The number of registered trademarks and designs
- The number of new and / or improved products and services brought to market in the supported companies and sectors
- The number of start-ups in the supported sectors
- The number of new Luxembourg companies in the supported sectors
- The percentage increase in employment in supported companies
- Number of enterprises cooperating with public research performers
- Total employment figures
- R&D expenditure in the public sector in percentage of GDP
- R&D expenditure in the business sector in percentage of GDP

[26] *"Measuring innovation output in Europe: towards a new indicator" {COM(2013) 624}*

6.3

RIS3 strategy benchmarking using the RIS3 Assessment Wheel synthetic tool

The RIS3 Assessment Wheel tool[27] will allow for a synthetic representation of the evolution of the RIS3 strategy and in following its periodic updating. In particular, it will facilitate a broad based benchmarking with similar member states and regions. The retained elements in the Lux RIS3 Assessment Wheel tool are presented in the following table:

RIS3 Guide Steps	Sections	Short explanatory
ANALYSIS OF NATIONAL CONTEXT	National assets	National budget and assets for research, development and innovation
	Outward dimension	Connectivity, knowledge flows, trade trans-regional/international MOU's
	Entrepreneurial dynamics	Start-ups, clusters, entrepreneurial networks, foreign direct investment
SHARED VISION	Broad view of innovation	Are social, organizational, service and market innovation considered beside technological and science-based innovation?
	Grand challenge	Diversification
	Scenario analysis	Risk assessment for possible future changes
IDENTIFICATION OF PRIORITIES	Revision of past priorities	Critical revision of past experiences. Dynamic identification of potential areas with competitive advantages
	Consistency	Alignment with context analysis and harvesting of entrepreneurial discoveries and DAE
	Critical mass	Concentration of resources to a limited number of priorities
POLICY MIX	Roadmap	Implementation plan
	Balance	Appropriate mix of targeted and horizontal measures
	Depth	Connection with national innovation Policy
GOVERNANCE	Governance structures	Identification of specific bodies and definition of their tasks, roles and responsibilities
	Broad participation	Interactive, consensus-based involvement of actors
	Management & communication	Broad based discussion
MONITORING & EVALUATION	Output & result indicators	Selection of a limited number of Output & Result Indicators
	Monitoring	Mechanisms, supported by appropriate data collection, to verify how the activities in the RIS3 strategy are delivering the Output and Result Targets
	RIS3 update	Revision of priorities and policy mix as a result of the monitoring exercise

Table 6.3: Elements of Assessment Wheel tool for RIS3 auto-evaluation

[27] *http://s3platform.jrc.ec.europa.eu/ris3-assessment-wheel*

The wheel will be built on the basis of the six steps described in the RIS3 Guide and the identification of three critical factors for each step.

The scaling tool (from 0 to 5) estimates the seriousness of the evidence provided in the process as far as each critical factor is concerned with the following meaning: 0 = no information available on the specific element; 1 = poor; 2 = to be improved; 3 = fair; 4 = strong; 5 = excellent.

Once the assessment is complete, the final result would appear in a form of "spider graph" where the strongest and weakest positioning would be easily highlighted.

This assessment will be done in the upcoming periods.

7 OUTLOOK

It is opportune and appropriate, in concluding this second cycle of the Luxembourg RIS3 to also outline current thoughts on the future evolution of our smart specialisation priorities post the existing ERDF programme in 2020. In particular, in the specific context of digitalisation initiatives within the Luxembourg Ministry of the Economy to support both the emerging Luxembourg and European data economy.

The background digital context is that the Luxembourg economy is rapidly becoming digital. Information and Communications Technology (ICT) whilst a specific priority sector is also increasingly the foundation of our innovative economy and smart society. Digital technologies are transforming the lives we lead, the way we work and how we communicate, as they become more integrated across all sectors of our economy and society. These changes are happening at a scale and speed that bring immense opportunities for innovation, growth and jobs in Luxembourg, as highlighted in the Third Industrial Revolution.

Luxembourg has recognised that in this second decade of the 21st century, digital data and infrastructure are considered as strategic economic assets in all advanced nations as reflected in the Digital Lëtzebuerg initiative. In addition, the investments made over the last years in digital infrastructure places Luxembourg number 2 in the European Union. And yet, in the coming two years, Luxembourg will once again make unprecedented investments in underpinning its digital competitiveness, through building out a high performance computing (HPC) enabled digital data processing capability and competence centre to support future public and private requirements across research, innovation and industry communities.

In this regard, Luxembourg, in strong collaboration with France, Italy and Spain, is already supporting a European HPC & Big Data initiative to accelerate the creation of a robust HPC ecosystem in Europe, with a strong focus on supporting European small and medium industry (SMEs). It is complementary to and has strongly contributed into the embryonic EuroHPC action recently initiated by the European Commission and of which Luxembourg is a founding member.

Over the coming years, Luxembourg will leverage its HPC assets to accelerate the digitalisation-enabled transformation of its industry across all sectors, both traditional and advanced. A vibrant Luxembourg Digital Innovation Hub will underpin this digitalisation of industry process.

Luxembourg will also fully participate in the ramp-up of the European HPC & Big Data ecosystem, in particular, through seeking synergies to support the Digital Pole of the European Commission in Luxembourg.

THE GOVERNMENT
OF THE GRAND DUCHY OF LUXEMBOURG