MONITORING PROGRESS IN NATIONAL INITIATIVES ON DIGITISING INDUSTRY

Country report

Luxembourg

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Summary

In terms of digitalisation, Luxembourg is performing really well. According to the overall Digital Economic and Social Index (DESI), the country is ranked 5th in 2018 (same position as in 2017). Luxembourg's main strengths are its e-leadership and digital infrastructure, with a good performance in terms of human capital and use of internet services by its population. However, Luxembourg belongs to the medium performing countries for the integration of digital technologies by companies and for digital public services.

Luxembourg's GDP has increased over the past years, which is mainly due to the performance of its financial sector. In comparison, the ICT sector plays a small role in the national total added value and a relatively small share of Luxembourg's GDP is invested in ICT.

However, the Luxembourgish government has launched an ambitious roadmap (the Third Industrial Revolution strategy, 2015) to make the country less dependent on the financial sector and to prepare for the Third Industrial Revolution. This revolution should put the ICT, renewable energy and a more sustainable lifestyle at the core of the society. The main national strategy to support this digital transition is Digital Luxembourg which acts in cooperation with several national initiatives and programmes relevant for different pillars of the Digitising European Industry (DEI) strategy. Overall, the budget identified across the different initiatives in Luxembourg amounts to at least EUR 522,000 although this figure is incomplete since the funding of several initiatives could not be identified.

Luxembourg has a network of start-up incubators that provide expertise and support to SMEs and start-ups, relevant for the Pillar 2 of the DEI. In addition, two national programmes support SMEs (Fit4Digital which grants minimum EUR 5,000 to SMEs) and ICT start-ups (Fit4Start which grants minimum EUR 5,000 to start-ups) in their growth and digital transition through financial support but above all, tailored expertise and coaching sessions. Luxembourg can also rely on a network of seven clusters, among which one for ICT and one for manufacturing, that foster synergies between research and industry and support enterprises in their digital transition (Pillars 2 of the DEI). In addition, Luxembourg can rely on two large-scale public-private partnerships relevant to the implementation of Pillar 3. Digital4industry is a platform that aims to raise awareness about digitalisation and the LIST is a Research and Technology Organisation which fosters synergies between research and industry. Finally, several support mechanisms provide additional funding to companies, with a budget of at least EUR 150 million.

The country has implemented several initiatives relevant for Pillar 5 and the development of e-skills for its population. Digital4Education, Fit4coding (EUR 522,000), The Cybersecurity Competence Centre (C3) and The Digital skills bridge all support the development of digital skills for youngsters, job seekers or companies. The Luxembourgish regulatory framework has also been adapted to fit the digital transition of the country (pillar 4 of the DEI) with three main laws which cover the legal status of e-documents, the free access of public data and financial support to R&D.

Table 1 presents an overview of the initiatives. Table 2 presents a short SWOT analysis of Luxembourg on digitalisation.

Table 1: Overview of initiatives

Initiatives	Starting year	Overall strategy/ DEI Pillar/ support mechanism	Type of initiative	Sectors targeted	Digital technologies targeted	Size of companies targeted	Budget
Digital Luxembourg	2014	Overall strategy	Public-private partnership; funding	All	All	All	The overall budget is not available. Initiatives that fall under this umbrella strategy are co-funded by national and European funds.
The third industrial revolution strategy (the Rifkin strategy)	2015	Overall strategy	Roadmap	Renewable energy, ICT, transport, research, food production and finance.	All	All	This strategy is a roadmap. No information on the budget for the different implementing measures could be retrieved.
Smart Specialisation Strategy Luxembourg (RIS3)	2013	Overall strategy	Strategy for innovation	• Industry 4.0 • Cleantech • Healthtech • ICT	All	All	National, European funds.
Start-ups incubators	The oldest one (1535 creative hub) dates from 2011	Pillar 2	Digital Innovation Hubs; fablabs, testbeds	All	All	Start-ups	Detailed budget of every incubators is not available. The incubators are funded with public (national, regional, cities) and private funds.
Digital4industry	2016	Pillar 3	One-stop shop, public-private partnership	All	All	All	Public (Luxinnovation, Ministry of Economy), private (FEDIL) funds.
Luxembourg cluster initiative	2002	Pillar 2	Public-private partnership, Digital Innovation Hubs	Transport/ mobility, health, entertainment, recreation, information and communication, energy and utility, manufacturing/industry, forestry	The ICT cluster focuses on: • Consulting • Development • Big data • Cloud • Cybersecurity • Telecommunication • Internet	All	Public (state), private (investors) funds.

Initiatives	Starting year	Overall strategy/ DEI Pillar/ support mechanism	Type of initiative	Sectors targeted	Digital technologies targeted	Size of companies targeted	Budget
					• Fintech • Internet of Things • Artificial Intelligence		
Fit4Digital	2018	Pillar 2	Funding	All sectors	All technologies relevant for the digital transition of a company	SMEs	Public (State) fund. Each SME receives EUR 5,000 and can further receive public aid up to 50% of the costs incurred by its digital transition.
Fit4Start	2015	Pillar 2	Funding	ICT but also all innovative sectors impacted by technologies, since in 2018, 5 projects out of the 15 selected were from the Healthcare sector.[1]	All	Start-ups	National funds of EUR 5,000 for each start-up and a possible additional grant of EUR 100,000.
Luxembourg Institute for Science and Technology (LIST))	2015	Pillar 3	Public-private partnership	Manufacturing/industry, energy/utility, information/communication, Professional scientific and technical activities.	Cloud, IoT, Robotics and Automation Machinery, Big Data and Data Analytics.	Companies of all size.	Overall funding is not available but the funds are public (national).
Law of 25 July 2015 on electronic archive	2015	Pillar 4	Electronic archiving regulation	All.	Storage of electronic document	All.	N/A
Law of 23 May 2016	2016	Pillar 4	Open data regulation	Public sector.	Data ownership, data management.	All.	N/A
Law of 17 May 2017 for research, development and innovation	2017	Pillar 4	Industrial policy	All.	All.	All.	N/A
Digital4Education	2015	Pillar 5	Training centres	Education and social work, other services.	All.	The initiative targets	The overall funding is not available. The umbrella is funded by public national funds.

Initiatives	Starting year	Overall strategy/ DEI Pillar/ support mechanism	Type of initiative	Sectors targeted	Digital technologies targeted	Size of companies targeted	Budget
						youngsters, students.	
Fit4coding	2015	Pillar 5	Training centres	Information and Communication	Website development, coding.	The initiative targets job seekers.	A total of EUR 522,000 among which EUR 261,000 from the European Social Fund.
The Cybersecurity Competence Centre (C3)	2017	Pillar 5	Training centres	Information and Communication	Cybersecurity.	All companies.	The overall funding is not available. Funded by public funds (national) and private investors.
The Digital skills bridge	2018	Pillar 5	Training centres, investment grants	All sectors.	All.	All companies.	The overall funding is not available. Funded by public funds (national).
Digital Tech Fund	2016	Support mechanism	Investments in capital venture	• Cybersecurity; • FinTech; • Big Data; • Digital Health; • Digital Learning; • Internet of Things; • Next Generation Media; • Next Generation Communication Networks; • Satellite based information and communication technologies.	All.	ICT start-ups.	Budget of EUR 20 million. Funded by the government, the National Society for Credits and Investments, the University of Luxembourg and private investors.
R&D grants	n/a	Support mechanism	Subventions to R&D investments	All sectors as long as the beneficiaries demonstrate the innovative character of their project.	All.	All companies.	The National Society for Credits and Investments and the Ministry of Economy finance this fund. The minimum amount for the grants is EUR 1,000, big companies can receive up to 65% for their industrial research, middle-size companies up to 75% and SMEs up to 80%.

Initiatives	Starting year	Overall strategy/ DEI Pillar/ support mechanism	Type of initiative	Sectors targeted	Digital technologies targeted	Size of companies targeted	Budget
Luxembourg Future Fund	2015	Support mechanism	Investments in capital venture	ICT, cleantech and other technology sectors.	All.	All companies.	The fund is co-financed by the National Society for Credits and Investments (EUR 120 million) and the European Investment Fund (EUR 30 million). This fund is divided into three sub-funds: • Investments in Venture Capital funds; • Co-investments alongside Venture Capital funds; • Co-investments with Business Angels and Family Offices.

Table 2: SWOT of Luxembourg on digitalisation

Strengths:	Weaknesses:
- Performant digital infrastructure; - High level of digital literacy of the population; - Performant human capital.	- Overall low rate of integration of digital technologies by companies; - Average performance in digital public services; - Limited size of the Luxembourgish market;
Opportunities:	**Threats:**
- Ambitious umbrella strategy; - Several initiatives to support digital skills; - Several programmes to support SMEs.	- Dependence on the financial sector; - Need of a skilled workforce to support companies' digitalisation; - Need of financial resources to support global digitalisation.

1   General context

The objective of this report is to analyse the current status of national initiatives on digitising industry in Luxembourg. The analysis has been conducted against the background of the Digitising European Industry (DEI), which was the first industry-focused initiative of the Digital Single Market launched by the European Commission in 2016.

Similar country reports will be produced for each of the 28 EU Member States. These national reports allow to:

- Monitor the development of national initiatives on digitising industry;
- Compare different national approaches; and
- Identify best practices of national initiatives.

Monitoring and reporting back on the development of the existing national initiatives is an important element of the DEI initiative, and this report should be seen as one part of it.

For more details about the DEI and our methodological approach for the country report, please consult the document attached.

## 1.1   Economic context and status on digitisation

General economic context

Luxembourg's GDP per capita has increased by 1.42% between 2015 and 2017 with a peak in 2016 (+3.1% in comparison to 2015).[2] This growth has resulted in an increase in the Luxembourgish working population by 5.88% over the same period.[3] In Luxembourg, services accounted for 92.8% of the total value added in 2017.[4] Luxembourg's economy main resources come from the financial sector which represents 10.67% of the total added value in 2017. In comparison, the ICT sector accounted for 3.9% of this total added value (EUR 1,971 million) and the manufacturing industry for 5.4%.[5] According to the OECD, a relatively small share of Luxembourg's GDP is invested in ICT since the country ranked last out of the OECD members in 2015.[6]

Status of digitisation

According to the Digital Economic and Social Index (DESI), Luxembourg is performing very well in terms of digitalisation. The country ranked 5th in 2018 for the overall index and had the same position in 2017. As shown in the figure below, the digital performance of the country has constantly improved since 2014:

Figure 1: Luxembourg DESI score from 2014 to 2018.
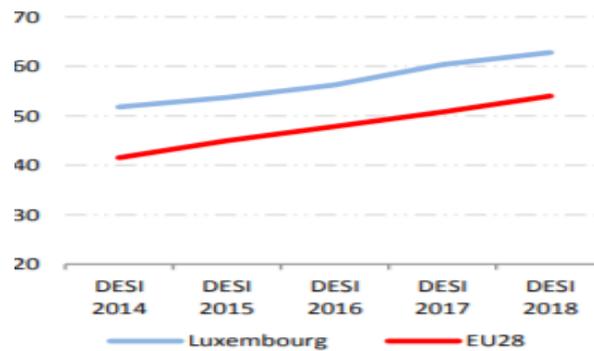
Source: DESI 2018 - Country report Luxembourg.[7]

Luxembourg's good performance relies on two main strengths: its e-leadership and powerful digital infrastructure. Luxembourg's performance in e-leadership is mainly due to its competitive human capital.[8] In 2017, 96% of the individuals in Luxembourg were regular internet users and 85% of individuals had at least basic digital skills .[9] In addition, the share of enterprises providing training to their personnel to develop their IT skills has increased by 12% from 2015 to 2017.[10] Luxembourg also performs very well in terms of digital infrastructure as there is an excellent access to high-speed broadband Internet in the country with a next generation access (NGA) coverage of 95 % and an ultrafast Broadband Coverage of 87%.[11] The government representative interviewed also underlined that the Luxembourg digital ecosystem is based on performant infrastructure.[12] However, the integration of digital technologies by companies is relatively low as shown by the share of SMEs selling online (in 2017, only 7.8 % of SMEs were selling online). The table below summarises some of the economic and digital indicators for Luxembourg:

Table 3: Overview of economic context and status on digitisation

	% GDP from manufacturing	"% GDP growth in comparison to the previous year	DESI position – and change	DESI sub-indicators Human Capital, Use of Internet, Integration of Digital Technology in 2018
Luxembourg	7.2% in 2017 (Eurostat)	In 2017, an increase of 2.3% in comparison to 2016	DESI position in 2017 and 2018:5th	• Human capital in 2018: 5th (2nd in 2017) • Use of Internet services in 2018: 4th (3rd in 2017) • Integration of digital technology in 2018: 22th (same as in 2017)

1.2 National strategy on digitising industry

The following table summarises the main national strategies that are described further below.

Table 4: Overview of the national strategies on digitising industry

Name	Digital Lëtzebuerg (Digital Luxembourg)	The third industrial revolution strategy (the Rifkin strategy)
Type	Public-private partnership; funding.	Roadmap to launch the third industrial revolution.
Starting date	2014	2015
Objective	Government initiative that aims to guide the country's digitalisation.	The Third Industrial revolution as conceptualised by J.Rifkin will be dominated by the ICT, renewable energy and new modes of transport. This strategy aims to prepare Luxembourg for this transition.
Ministry/ ministries in charge (website, contact person)	Ministry of Economy	Ministry of Economy
Scope of the strategy/ action plan	The strategy covers all the aspects of the digitalisation (skills, information, training, funding, regulations).	The strategy covers renewable energy, ICT, new modes of transport, research, food production and finance.
Measures included in the strategy/ action plan	The strategy is implemented through three axes: • Enable: supporting all actors that use digitalisation; • Support: helping impactful initiatives for digitalisation; • Inform: raising awareness and communicate about digital projects. The measures included cover: • The training of students, workforce and job seekers; • The building of a dynamic digital ecosystem; • The development of policies and regulations fit for the digital age; • The digitalisation of administration services. For instance, Digital Luxembourg implements several initiatives relevant for the digital transition such as Digicheck (see 2.1). Digital Luxembourg also acts as a public-private partnership and coordinates for instance dialogue on Artificial Intelligence via seminars[13] or information sessions about digitalisation advantages for SMEs.	Nine industrial measures have been launched: • The construction of a national smart energy grid; • The promotion of electromobility and mobility as a service; • The development of a programme for cars without emission; • A light house project for smart, sustainable end circular quarters/cities; • Development of joint technology platforms for business and public research; • Promotion of circular economy through public procurement; • A 'Sustainable Development Finance Platform'; • A roadmap for a sustainable food production. • High performance computing infrastructure.

Name	Digital Lëtzebuerg (Digital Luxembourg)	The third industrial revolution strategy (the Rifkin strategy)
Overall funding and distribution by volume and source of funding (public/private, EU/national)	The overall budget is not available. Initiatives that fall under this umbrella strategy are funded by public funds and supported by European funds.	This strategy is a roadmap. No information on the budget for the different implementing measures could be retrieved.

Digital Lëtzebuerg (Digital Luxembourg)

Digital Luxembourg was launched in 2014 as an ambitious umbrella initiative to support the country digitalisation.[14] The primary goal is to make Luxembourg a "smart nation" and to ensure a smooth and effective digital revolution. According to government representatives, the successive governments of Luxembourg have always paid great attention to the digitalisation of the country.[15] The aim is to depend less on the financial sector and ensure that the country will be able to cope with the transformation of the economy and society (digitalisation, energy issues…).[16]

Digital Luxembourg is also the name of the organisation that pilots the initiative through three missions:

- **Enable** the conditions and environment of all the actors that use digitalisation;
- **Support** digital initiatives through financial contributions, endorsement, and a better visibility.
- **Inform** about digital projects, communicate on the country's digital progress, close the gap between digitalisation and population and unite the digital community.

This initiative targets priorities clustered around five thematic areas:

- **Skills:** to support the digital literacy of the workforce through training programs and ensure that a growing share of the population has access to ICT education.
- **Ecosystem:** to encourage the creation of a dynamic environment as the basis of a prosperous digitalisation. Four priority areas are targeted: the start-ups, creative industries, fintech and innovation.
- **Infrastructure:** the aim is to provide Luxembourg with competitive and powerful ICT infrastructure by investing in cutting-edge technology, data centres and ultra-highspeed connectivity.
- **Policy:** to design the future political and regulatory framework to make it an engine for progress and digitalisation with an emphasis on open data, data protection, e-legislation, and the achievement of the Digital Single Market.
- **Government:** to pursue the goal of ensuring a full e-administration and digitalisation of public services.

The Digital Luxembourg strategy has already produced concrete results. Since 2016, all the legal instruments have been digitalised.[17] E-administration is also effective with MyGuichet, the e-portal on which citizens can process all their administrative procedures online.[18] The country has also started a massive liberalisation[19] of data and today public data (data held by public sector bodies) are considered as open by default and available on the Luxembourgish data platform. Another prime example of Digital Luxembourg's objective is the ambitious Luxembourg's strategy to rollout 5G network in the major cities of the country by 2025.[20]

Digital Luxembourg is known by the industry and deemed useful (out of a scale between 1 -low- and 5 -high- Digital Luxembourg received a score of 5).[21] Digital Luxembourg is seen as having a high impact for the uptake of digital technologies (out of 5 it received a score of 4). Digital Luxembourg benefits from an important visibility at the national level and is the main actor in contact with the digital ecosystem. But given the long-term perspective of the projects, the

government needs to communicate on the results to highlight their importance according to stakeholders.

The strategic study for the Third Industrial Revolution ("Rifkin study")

In 2015 the Minister of Economy, together with the Chamber of Commerce launched a study "Third Industrial Revolution". In collaboration with the economist Jeremy Rifkin, the study presents a socio-economic analysis of the country and includes a roadmap to lead the country on its way to the Third Industrial Revolution. In 2016, the government of Luxembourg announced nine implementing measures:[22]

- The construction of a national smart energy grid;
- The promotion of electromobility and mobility as a service;
- The development of a programme for cars without emission;
- A light house project for smart, sustainable end circular districts/cities;
- The development of joint technology platforms for business and public research;
- The promotion of circular economy through public procurement;
- A Sustainable Development Finance Platform;
- A roadmap for a sustainable food production;
- A high-performance computing infrastructure.

A review of the strategy implementation in 2018 has estimated that the two main measures dealing with digitalisation, namely the development of joint technology platforms for business and public research and the high-performance computing infrastructure, had respectively achieved up to 25% and 80% of their final objectives.[23]

The main initiatives for the digitalisation of the administration are still too recent to yield results (most of them dated from 2016) and progress still need to be made in this field. However, the opening of public data has already produced concrete impacts as 57% of data were open to the public in 2016 while this share achieved 85% in 2017. In addition, as shown in section 1.1, the Digital Luxembourg strategy is already making good progress in terms of overall connectivity. [24]

The Luxembourg government programme has established in 2013 its "multi-sectorial" strategy to diversify its economy.[25] The **Research and Innovation Smart Specialisation Strategy Luxembourg** (RIS3) aims to implement the European smart specialisation initiative in Luxembourg. In order to maximise the efficiency of the European funds, Luxembourg has identified four priority sectors: Industry 4.0, cleantech, healthtech, ICT.

Several instruments have been implemented in the context of this smart specialisation strategy. The main ones are further developed in the next sections: the Cybersecurity Competence Centre Luxembourg (C3), Luxinnovation programmes or Research, Development and Innovation funds.

1.3 EU cooperation in the field of digitising industry initiatives

European High-Performance Computing Joint Undertaking

Luxembourg hosts the European High-Performance Computing Joint Undertaking.[26] The Joint-Undertaking pools the resources of 25 EU countries (among which Luxembourg) in order to build

a world-class supercomputing infrastructure. Activities will start with open-calls and procurement in 2019 and 2020 and the supercomputing infrastructure will operate from 2019 to 2026.

Data embassy

Given its world-class data centres infrastructures, Luxembourg hosts the first data embassy in the world. Estonia stores its most confidential data in the highly secure data centre of Betzdorf. This first type of embassy is the fruit of a partnership between the two countries and constitutes a precedent in international law.[27]

Cross-border testbed for automated and connected vehicles

In September 2017, Luxembourg, France and Germany signed an agreement to test innovative technologies linked to automated and connected vehicles on a real-life situation.[28] The testbed site is located on the road network between Luxembourg, France, Germany. On the Luxembourg side, a key player of this initiative is the Luxembourg Automobility Cluster.

European Commission coordinated plan on Artificial Intelligence

On December 2018[29], the European Commission adopted a coordinated plan to foster the development of AI in Europe. This plan supports a greater synergy between national and EU AI actions and policies.

Blockchain partnership

The 10 April 2018[30], the European Union Member States and Norway signed a Declaration creating the European Blockchain Partnership. This partnership aims at supporting cooperation between the EU and the member States for the creation of an enabling environment, which will support the development of blockchain services.

ECSEL Joint Undertaking

The ECSEL Joint Undertaking is the European public private partnership for Electronic Components and Systems. It aims to enhance the competitiveness of this sector in Europe, support companies, SMEs and research centres and foster a greater synergy between industry and research. The ECSEL launches calls for Proposals for research, development and innovation projects. Luxembourg is a member of this Joint Undertaking.

2   Other policy support to digitising industry

2.1   Boosting innovation capacity

The table below summarises the main initiatives that support the digitalisation of industry in Luxembourg (Pillars 2 and 3 of the DEI).

Table 5: Overview of initiatives to boost innovation capacity

Name	Luxembourg cluster initiative	Start-ups incubators	Luxembourg Institute for Science and Technology (LIST)	Fit4Digital	Fit4Start	Digital4industry
Type	Clusters	Fablabs, testbeds	Public-private partnership	Support and coaching	Diagnosis and coaching	One-stop shop, public-private partnership
Starting date	2002	The oldest one (1535 creative hubs) dates from 2011.	2015	2018	2015	2016
Objective	To develop research and development and support the synergy between research and industry through competitive clusters.	To provide start-ups with infrastructure to test innovations, research, network, receive support.	To develop research and synergy with the industry on: Smart Cities, Smart Finance, Smart Space and Smart Manufacturing.	To support SMEs in their digital transition.	Acceleration programme for ICT innovative start-ups.	To raise awareness and inform about digitalisation.
Relevant for Pillar 2[31] or Pillar 3[32] or both	Pillar 2	Pillar 2	Pillar 3	Pillar 2	Pillar 2	Pillar 3
Short description	Luxembourg has seven clusters among which one is dedicated to ICT: • AutoMobility Cluster; • BioHealth Cluster; • Creative Industries; • EcoInnovation Cluster; • ICT cluster;	Network of start-ups accelerators, incubators and working spaces that constitute the Luxembourg's start-up ecosystem. A significant	As the Research and Technology Organisation of Luxembourg, it aims to: • Develop technological expertise and know-how; • Enhance synergy between public and private actors active in innovation;	The programme aims to support SMEs' in their digital transition with tailored expertise and financial support.	The programme supports ICT start-ups in their growth with coaching sessions, funding and working spaces.	The platform is the result of the partnership between the business association of Luxembourg, the Ministry of Economy and the national agency for

Name	Luxembourg cluster initiative	Start-ups incubators	Luxembourg Institute for Science and Technology (LIST)	Fit4Digital	Fit4Start	Digital4industry
	• Materials & Manufacturing cluster; • Wood Cluster.	share of start-ups is active in digital related areas.	Develop a strategy of cooperation across Europe and worldwide.			innovation and research. It aims to inform, raise awareness about digitalisation and showcase success stories of digital transition.
Granting organisation	Government of Luxembourg, Luxinnovation, private capital providers. 14 capital providers are listed on the ICT cluster website.[33]	Government of Luxembourg, regions, cities.	University of Luxembourg, the business incubator Technoport, Luxinnovation and the National Research Fund (FNR).	Government of Luxembourg, Luxinnovation.	Government of Luxembourg, Luxinnovation.	The FEDIL (business association), the Ministry of Economy, Luxinnovation (national agency for innovation and research).
Participating organisations	36 members listed on the ICT cluster website.[34]	Start-ups.	Companies of all size.	SMEs.	At least 55 SMEs since the beginning.[35]	Companies of all size.
Sectors targeted	Transport/ mobility, health, entertainment, recreation, information and communication, energy and utility, manufacturing/ industry, forestry.	All sectors.	Manufacturing/industry, energy/utility, information/communication, Professional scientific and technical activities.	All sectors.	ICT but also all innovative sectors impacted by technologies, since in 2018, 5 projects out of the 15 selected were from the Healthcare sector.[36]	All sectors.

Name	Luxembourg cluster initiative	Start-ups incubators	Luxembourg Institute for Science and Technology (LIST)	Fit4Digital	Fit4Start	Digital4industry
Technologies targeted	The ICT cluster focuses on: • Consulting • Development • Big data • Cloud • Cybersecurity • Telecommunication • Internet • Fintech • Internet of Things Artificial Intelligence.	All technologies.	Cloud, IoT, Robotics and Automation Machinery, Big Data and Data Analytics.	All technologies relevant for the digital transition of a company.	All technologies.	All technologies.
Funding (split by private/public and national/EU), state period/annual funding	Public (state), private (investors) funds.	Detailed budget of every incubators is not available. The incubators are funded with public (national, regional, cities) and private funds.	Overall funding is not available but the funds are public (national).	Public (State) fund. Each SME receives EUR 5,000 and can further receive public aid up to 50% of the costs incurred by its digital transition.	National funds of EUR 5,000 for each start-up and a possible additional grant of EUR 100,000.	Public (Luxinnovation, Ministry of Economy), private (FEDIL) funds.
Current status of initiatives		Ongoing	Ongoing	Ongoing	Ongoing	Ongoing

Luxembourg cluster initiative

Another relevant policy supporting industry digitalisation is the Luxembourg cluster initiative managed by Luxinnovation. There are seven clusters referenced in Luxembourg, including one dedicated to ICT and one to manufacturing.

These clusters bring together public and private actors to increase the synergy between research and industry and networking opportunities. The Luxembourg Cluster Initiative has set the goal of creating 300 new companies and 3,000 new jobs by 2020.[37] The ICT cluster's goal is to foster the uptake of ICT technologies and assists users with tailored activities and guidance. The cluster provides 4 types of services:

- Business development support in line with Luxembourg's priorities (cybersecurity, fintech, big data, the Internet of Things, high-performance computing, artificial intelligence, blockchain);
- The support of ICT start-ups to develop their client's portfolio;
- The support of start-ups internationalisation;
- The support of networking activities;
- The initiation of projects.[38]

The Luxembourg Materials & Manufacturing Cluster focuses on composite materials, bio-sourced materials, nanomaterials, industry 4.0, additive manufacturing and automation/robotics. The aims are to contribute to the implementation of new technologies, promote the Luxembourg industry, stimulate innovation and business development through five services:

- Business development,
- Support members' R&D and the development of innovation projects;
- Support members in finding funding opportunities;
- Identification of key technologies suitable for members' activities;
- Support of partnerships.

A network of 15 start-ups incubators

Luxembourg has a strong network of 15 start-ups incubators scattered across the country, which is supported by the national strategy Digital Luxembourg.[39] They serve as DIHs, fab labs and are designed to provide start-ups with co-working facilities where they can test cutting-edge technologies, receive tailored expertise, guidance and meet potential investors. A prime example of these incubators is the **Luxembourg House of Fintech**. Building on Luxembourg's expertise in the financial sector, it fosters synergy between financial services and technology to develop the future of Fintech.[40]

The Luxembourg Institute for Science and Technology (LIST)

In 2015, the Luxembourg Institute for Science and Technology (LIST)[41] was created as the Research and Technology Organisation of Luxembourg. It establishes links between research and society by:
- Developing the technological expertise, know-how in support of four programmes: Smart Cities, Smart Finance, Smart Space, and Smart Manufacturing;
- Enhancing synergy between public and private actors active in innovation;
- Developing a strategy of cooperation across Europe and worldwide.

Located on the former industrial site of Belval, the campus hosts the European High Performance Computing (HPC) facility. The site gathers Luxembourgish research players with the University of Luxembourg, the business incubator Technoport, Luxinnovation and the National Research Fund (FNR). LIST has three departments: Environmental Research & Innovation (ERIN), Materials Research and Technology (MRT), IT for Innovative Services (ITIS).[42] The ITIS department hosts 110 scientists and software engineers working in the following research units: Business Analytics and Regulatory Technologies, Human Dynamics in Cognitive Environments, Trusted Service Systems, Digital Built Environment Management. Currently, this department references 18 ongoing research projects.

Fit4Digital

Fit4Digital[43] is the Luxembourg programme that supports Luxembourg SMEs in their digital transition. The programme, supported by Luxxinnovation, starts with a diagnosis of the strengths and weaknesses of the company's digital profile via the **Digicheck** programme. Digicheck is an online assessment tool that enables companies to assess their digital maturity. Users participate in a ten-minutes questionnaire around six pillars - communication, management, human resources, security, regulation and production and services- and receive a profile with digitalisation percentage and recommendations. Then, a network of consultants assists the SMEs with concrete recommendations and an action plan to digitalise their activities. At the end of the diagnosis phase, SMEs can receive a financial support (section 2.4).

Fit4Start

Fit4Start[44] is an acceleration programme organised by Luxinnovation dedicated to innovative ICT start-ups. Selected start-ups can benefit from 16 weeks of expert coaching, a free access to co-working space. A financial support to eligible start-ups is also foreseen (see section 2.4).

Digital4industry

Digital4industry[45] plays a key role in Luxembourg's digital transition. The platform is part of the European Platform for co-ordination of initiatives for digitising industry and is the result of a collaboration between the FEDIL (The business federation of Luxembourg), Luxinnovation – the National Agency for Innovation and Research - and the Luxembourg Ministry of the Economy. This private-public partnership fulfils three missions through the platform:

- To raise awareness and inform about the risks and opportunities related to digitalisation;
- To identify specific challenges related to digitalisation;
- To initiate pilot projects to showcase success-stories related to digitalisation.

In concrete terms, the platform informs companies about Industry 4.0, thematic conferences organised in Luxembourg and where to find relevant information.

Other support mechanisms are relevant support to initiatives falling under Pillar 3 of the DEI. They are presented in section 2.4.

Impacts, perceptions and challenges

In order to reduce the dependence of Luxembourg on the financial sector, the country has launched multiple initiatives to support the digitalisation of its industry. As detailed above, Luxinnovation and Digital Luxembourg have initiated several programmes with the goal to promote synergy between research and industrial innovations. Luxembourg can rely on a network of seven cluster organisations, 15 start-ups incubators and DIHs, a world-class research and technology organisation as well as funding and tutoring programmes to assist SMEs.

The main initiatives are known by the industry and are deemed useful (in average the usefulness of the initiatives received a score of 3.5 on a 1-5 scale where 1 is low and 5 is high).[46] The Cluster Initiative is perceived as the one with the highest impacts for the uptake of digital technologies (out of 5 it received a score of 4 while the average score for the uptake of digital technologies due to the initiative was 2.5 on a 1-5 scale). The Cluster initiative can rely on a powerful network of key companies with significant resources to develop relevant projects.[47] However, SMEs are often not aware of the potential benefits to participate in these types of clusters.[48] Overall, government support to industry digitalisation is perceived as very satisfactory by the different actors (this support received an average score of 4 on a 1-5 scale).

However, despite an overall good level of digitalisation (section 1.1), the integration of digital technologies by Luxembourgish companies is relatively low. The percentage of enterprises with high level of digital intensity has even decreased by 14% from 2015 to 2016. This can be partly explained by the gap between ICT and non-ICT companies in terms of uptake of technologies. Indeed, one industry representative mentioned that non-ICT sectors were not as digitalised as ICT companies.[49] In non-ICT sectors, the gap is even wider between SMEs and non-SMEs given the limited financial resources of the former.[50] According to stakeholders interviewed, the main types of challenges to the uptake of digital technologies in Luxembourg are the limited size of the Luxembourgish market and the financial resources needed to invest in digital technologies.[51]

2.2   Regulatory framework for digital age

The table below provides an overview of the main regulatory initiatives for a digital age in Luxembourg (Pillar 4 of the DEI).

Table 6: Overview of the regulatory framework for a digital age

Name	Law of 25 July 2015 on electronic archive	Law of 23 May 2016	Law of 17 May 2017 for research, development and innovation
Type	Electronic archiving regulation	Open data regulation	Industrial policy
Starting date	2015	2016	2017
Objective	To regulate the legal status of e-document storage.	To free the access to public data.	To regulate financial support for R&D and innovation investments.
Short description	This law provides the legal framework for the storage of e-document.	This law regulates the access and consultation of data owner by public bodies.	This law transposes the European Regulation declaring certain categories of aid compatible with the internal market.

Name	Law of 25 July 2015 on electronic archive	Law of 23 May 2016	Law of 17 May 2017 for research, development and innovation
Sectors targeted	All.	Public sector.	All.

Law of 25 July 2015 on electronic archive[52]

This law grants a legal status to the documents stored electronically. It aims to implement quality control criteria and certification for their storage.

Law of 23 May 2016

The law of 23 May 2016[53] on free access to public data is part of the broader Open Data strategy. The objective of the strategy is to progressively free access to all public data. With this Law, documents owned by public bodies and produced in the scope of their public service mission are defined as open by default and available on the open data platform[54].

Law of 17 May 2017 for the research, the development and the innovation[55]

This law transposes the European Regulation declaring certain categories of aid compatible with the internal market[56]. Its purpose is to frame the different aid regimes that support companies' investments in digitalisation.[57]

Impacts, perceptions and challenges

In addition to the main regulations above, the transposition of the NIS Directive in Luxembourg is still in progress. Luxembourg has already appointed the Luxembourg Institute for Regulation as the competent authority for cybersecurity issues for Operators of Essential Services (Energy, Transport, Banking and financial market infrastructures, health sector, drinking water supply and distribution) and for Digital Service Providers.[58] According to government feedback, one of the main challenges for digital regulation is to keep pace with the fast-moving technology. In addition, regulation is often national wide while digital is global.[59] From an industry perspective, when companies need to hire foreign staff, the long period to obtain a visa can be an obstacle to the recruitment process. There is also a strong competition due to the fact that several other countries have implemented national strategies to attract a skilled workforce.[60]

2.3 Skills development

The table below provides an overview of the skills development initiatives in Luxembourg (Pillar 5 of the DEI).

Table 7: Overview of the initiatives for skills development

Name	The Cybersecurity Competence Centre (C3)	The Digital skills bridge	Fit4coding	Digital4Education
Type	Training centres	Training centres	Training centres	Training centres
Starting date	2017	2018	2015	2015
Objective	To improve cybersecurity in Luxembourg.	To train employees and support companies in their digital transition.	To train job seekers with digital skills.	To educate students, youngsters with digital skills.
Short description	This competence centree aims to be at the forefront of the latest development in cybersecurity in order to train companies in Luxembourg.	This initiative aims to train employees and companies which will have their activities impacted by digitalisation.	Job seekers are trained to become web-developer.	Through different initiatives (e.g. BEE Creative makerspaces, Future Hub Label, Luxembourg Tech School) Digital4Education aims to prepare the future workforce to digital challenges.
Granting organisation	Ministry of Economy	Government of Luxembourg	Government of Luxembourg and the European Union	Ministry of Education
Participating organisations	Companies.	For the pilot of the initiative (2018) more than 20 companies have taken part in the training.	Job seekers.	Schools.
Sectors targeted	Information and Communication	All sectors	Information and Communication	Education and social work, other services
Funding (split by private/public and national/EU), state period/annual funding	The overall funding is not available. Funded by public funds (national) and private investors.	The overall funding is not available. Funded by public funds (national).	A total of EUR 522,000 among which EUR 261,000 from the European Social Fund.[61]	The overall funding is not available. The umbrella is funded by public national funds.
Current status of initiatives		Ongoing	From 2015 to 2017	Ongoing

The Cybersecurity Competence Centre (C3)

Launched in 2017, this competence centre aims to enhance cybersecurity in Luxembourg through three missions:[62]

- The collection of data and information on cybersecurity threats to help businesses and organisations to protect themselves.
- Training programmes provided to companies.
- The test of companies' cybersecurity resilience.

The Digital skills bridge

This initiative aims to support companies and their employees whose activities will be transformed by digital changes to upskill competencies. Employees can receive an assessment of their digital skills, guidance and tailored training for upskilling to prepare their internal or external mobility. Companies receive help to digitalise their activities thanks to a new skilled workforce or by identified opportunities offered by the digitalisation. A pilot phase has been launched in 2018.[63]

Fit4coding

This 3-month training programme was designed to job seekers who wanted to integrate the job market in digital sectors.[64] They received a formation on coding and were then able to find a job as web-developer. Classes were held on the site of the Technoport hub.

Digital4Education

In 2015, the Luxembourg Ministry of Education launched the **Digital4Education** strategy. The goal is twofold: educate youngsters with digital skills and know-how and prepare the future workforce. Part of this strategy are the six **BEE Creative makerspaces**. On these sites, youngsters can use digital tools to take part in digital projects and to use their creativity. They can attend training about programming, cryptography, robotic, design, audio-visual conception. **The Future Hub Label** has been launched to promote performant high schools in the field of ICT. Three high schools have already received the future hub label and will operate as specialised school in IT and put the emphasis on programming, big data management, FinTech application and video games development.[65] A **Luxembourg Tech School** was set up in 2016 as an extracurricular school concept providing training to 15-20 years old students about Game development, big data, FinTech, Space Resources and Finance.[66]

Impacts, perceptions and challenges

Luxembourg has put a great emphasis on training its population with digital skills. As shown by the figures, the outcomes are really positive. As mentioned in this report, one of the strengths of Luxembourg is the e-skills level of its population and the digital literacy of the students and youngsters.[67]

Figures also show that companies are anticipating the digitalisation of their activities. Indeed, the proportion of persons employed with ICT specialist skills has increased by 13% from 2015 to 2017. However, a significant share of companies in Luxembourg has reported the difficulty to fill their vacancies for positions requiring ICT skills.[68] The above initiatives (e.g. Fit4coding, Digital skills bridge) aim to fill this shortage and to upskill the workforce to support the digital transformation of Luxembourgish companies.

2.4 Support mechanisms

Digital Tech Fund

Part of the Digital Luxembourg strategy, this fund was established in 2016 with the aim to financially support the development of ICT start-ups from Luxembourg.[69] The fund targets the following sectors:

- Cybersecurity;
- FinTech;
- Big Data;
- Digital Health;
- Digital Learning;
- Internet of Things;
- Next Generation Media;
- Next Generation Communication Networks;
- Satellite based information and communication technologies.

This funding supports directly capital venture. The first investments have been announced in August 2017.

R&D grants

Enterprises that invest in R&D projects can receive subventions from the Ministry of Economy. The minimum amount for the grants is of EUR 1,000 and big companies can receive up to 65% for their industrial research, middle-size companies up to 75% and SMEs up to 80%.

In addition, the National Society for Credits and Investments grants direct loans for research, development and innovation projects to innovative SMEs. To be eligible to this grant, potential beneficiaries have to demonstrate the innovative character of their projects.[70]

These R&D grants are relevant for Pillar 3.

Luxembourg Future Fund

Created in 2015, the Luxembourg Future Fund aims to support the diversification of the Luxembourgish economy by investing in innovative SMEs or companies active in ICT, cleantech and other technology sectors over a 5 years period.[71] This fund is divided into three sub-funds:

- Investments in Venture Capital funds;
- Co-investments alongside Venture Capital funds;
- co-investments with Business Angels and Family Offices.

To be eligible, investments should have an expected positive spillover effects on turnover generated by companies established in Luxembourg, direct costs reduction in Luxembourg, or significant employment creation in Luxembourg. The fund is co-financed by the National Society for Credits and Investments (EUR 120 million) and the European Investment Fund (EUR 30 million).[72]

Financial support to SMEs and ICT start-ups.

With the **Fit4Digital** initiative (see section 2.1), eligible SMEs can receive a financial support of EUR 5,000, which plays the role of an innovation voucher. A further public aid up to 50% of the costs incurred by their digital transformation is also implemented. The **Fit4Start** programme foresees a EUR 5,000 for every start-up which participated and a possible additional grant of EUR 100,000.

3   Conclusions

Luxembourg has several national initiatives that fall under the different pillars of the DEI strategy. The table below shows their funding clustered per pillars of the DEI. Since the budget of most initiatives is not available, the overall budget is very low.

Table 8: Overview of funding of the initiatives

	Pillar 2 **Digital Innovation for all**	Pillar 3 **Partnerships and industrial platforms**	Pillar 4 **Regulatory framework for digital age**	Pillar 5 **Preparing for digital future (skills)**
Start-ups incubators	n/a			
Digital4industry		n/a		
Luxembourg cluster initiative	n/a			
Fit4digital	Each SME receives EUR 5,000 and can further receive public aid up to 50% of the costs incurred by its digital transition.			
Fit4Start	National funds of EUR 5,000 for each start-ups and a possible additional grant of EUR 100,000.			
Luxembourg Institute for Science and Technology (LIST)		n/a		
Law of 25 July 2015 on electronic archive			n/a	
Law of 23 May 2016			n/a	
Law of 17 May 2017 for research, development and innovation			n/a	
Digital4Education				n/a
Fit4coding				EUR 522,000
The Cybersecurity Competence Centre (C3)				n/a
The Digital skills bridge				n/a
Digital Tech Fund	n/a			
R&D grants	The minimum amount for the grants is of EUR 1,000 and big companies can receive up to 65% for their industrial research, middle-size companies up to 75% and SMEs up to 80%.			
Luxembourg Future Fund	The fund is co-financed by the National Society for Credits and Investments (EUR 120 million) and the European Investment Fund (EUR 30 million).			
Total spending	At least EUR 150,522,000 (including EUR 150 million from support mechanisms)			

Digital Luxembourg, as the main umbrella strategy and one of the main bodies that lead digital policies in the country, supports several initiatives relevant for Pillars 2,3.

In Luxembourg, several initiatives are key for the implementation of pillar 2 of the DEI. The network of start-up incubators and clusters provide facilities to companies where to test technology, to receive advice, to network and to meet potential investors. Fit4digital and Fit4start provide guidance to SMEs in their digital transition or support ICT start-ups in their growth. All these initiatives still need to yield concrete results as the integration of digital technologies by companies in Luxembourg is still relatively low in comparison to the EU average.

With regards to Pillar 3 of the DEI, Digital4industry and the LIST are the main large-scale public-private partnerships that support digitalisation. The first one is a platform that aims to raise awareness about the different opportunities entailed by the digital transformation. As for the LIST, it aims to transfer innovation from research to the industry.

All these programmes and initiatives aim to decrease the dependence of the Luxembourgish economy on the financial sector. Indeed, the Third Industrial Revolution Strategy and Digital Luxembourg aims to support the ability of the country to cope with the challenges of the future (the need for a more sustainable society, greener transport and the greater integration of ICT in people's day-to-day life).

Luxembourg overperforms the rest of the EU in terms of digital literacy and the digital skills level of its population. All the initiatives relevant for Pillar 5 of the DEI (Digital4Education, Fit4coding, The Cybersecurity Competence Centre (C3), The Digital skills bridge) intend to continue this education effort. For instance, the Digital skills bridge initiative aims to support companies and their employees whose activities will be transformed by digital changes to upskill competencies. Employees can receive an assessment of their digital skills, guidance and tailored training for upskilling to prepare their internal or external mobility. Companies receive help to digitalise their activities thanks to a new skilled workforce or by identified opportunities offered by the digitalisation. A pilot phase has been launched in 2018.[73]

Luxembourg has implemented several legislative measures to fit its regulatory framework with the digital age (Pillar 4 of the DEI), which shows the move to adapt the Luxemburgish society to the digital era.

Fit4Digital[74] is the Luxembourg programme that supports Luxembourg SMEs in their digital transition and can serve as a good example of the country's effort to digitalise its economy. The box below illustrates this good practice implemented in Luxembourg:

Box 1: Good practice

Fit4Digital helps SMEs to digitalise their activities. The programme assists SMEs from the diagnosis of their level of digitalisation and the development of concrete recommendations to a financial support.

SMEs that wish to digitalise their activities can start with a diagnosis of their level of digitalisation (via the Digicheck).

Then, the Fit4Digital initiative relies on a network of consultants who implement a concrete action plan to guide SMEs on their digitalisation and support them with tailored assistance and expertise.

At the end of the programme cycle, SMEs can receive a financial support of EUR 5,000 and a further public aid up to 50% to cover the costs incurred by their digital transformation.

The Fit4Digital programme shows the example of an initiative that supports the digitalisation of SMEs through all the steps of their transformation: diagnosis, action plan and financial support.

To conclude, the table below provides a general overview of the main digitalisation initiatives implemented in Luxembourg, the level of take-up and perception of their impacts as well as the overall progress Luxembourg has made so far with regard to digitalisation. The table below shows the application, usage and outcomes of the different initiatives clustered per pillars of the DEI.

Table 9: Input/ Output overview

		Pillar 2	Pillar 3	Pillar 4	Pillar 5
		Digital Innovation for all	**Partnerships and industrial platforms**	**Regulatory framework for digital age**	**Preparing for digital future (skills)**
Application	Name of key initiatives (start dates in brackets)	Luxembourg cluster initiative (2002) Start-ups incubators (2011), Luxembourg cluster initiative (2002), Fit4digital (2018), Fit4Start (2015).	Digital4industry (2016) Luxembourg Institute for Science and Technology (LIST) (2015)	Law of 25 July 2015 on electronic archive, Law of 23 May 2016, Law of 17 May 2017 for the research, the development and the innovation.	Digital4Education (2015), Fit4coding (2015), The Cybersecurity Competence Centre (2017), The Digital skills bridge (2018)
	Funding (total amount and period)	n/a	n/a		EUR 522,000 for Fit4Coding (2015-2017).
	Industries addressed	All the industries. But the clusters focus on: transport/ mobility, health, entertainment, recreation, information and communication, energy and utility, manufacturing/industry, forestry.	All the industries. But the LIST focuses on Cloud, IoT, Robotics and Automation Machinery, Big Data and Data Analytics.	All and the public sector for Law of 23 May 2016.	Information and Communication.
	EU programme involved	n/a	n/a	n/a	The European Social Fund.
Usage	Perception of initiative	Government support to digital transformation is perceived as really useful (4/5)		The regulatory framework is considered to have improved.	n/a
	Take-up	7 clusters and 22 start-ups incubators and at least at least 55 SMEs since the beginning.			n/a
Outcomes	Perception of outcomes	The perception of the level of uptake digital technologies by non-ICT industry is satisfactory (3/5)	The perception of the level of innovation in digital industries is elevated (3/5)	The regulatory framework is deemed fit for the digital age (4/5)	Digital skills of the workforce have well improved since 2015 (3.5/5)
	Outcome metrics	Despite an average rank for the integration of digital technology by companies (22th in 2018), the overall DESI ranking is excellent (5th in 2017 and 2018).		Between 2015 and 2017, total capex spending in Luxembourg increased by 12%.	The number of people employed with ICT specialist skills increased by 13% between 2015 and 2017. In the same period, the share of enterprises providing training to develop ICT skills has increased by 12%.
	Change in outcomes	Luxembourg overall score for the DESI has constantly increased since 2014. In 2018, Luxembourg ranking for integration of digital technologies was the same as in 2017 (22th)			
End-goal	Productivity growth	From 2010 to 2017, the real labour productivity per person employed in Luxembourg has decreased by 1%, despite an increase of 1,8% in 2013 in comparison to 2012.			
Summary		Luxembourg has recently launched several initiatives to help companies in their digital transition. Although most have been launched recently, the initiatives that aim to support digital skills have already produced good results.			

ANNEX 1 List of stakeholders interviewed

Type of stakeholder	Name of organisation
Representative of the Ministry of Economy	Ministry of Economy
Industry representative	Anonymous

ENDNOTES

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