

Artificial Intelligence:

a strategic vision for Luxembourg.

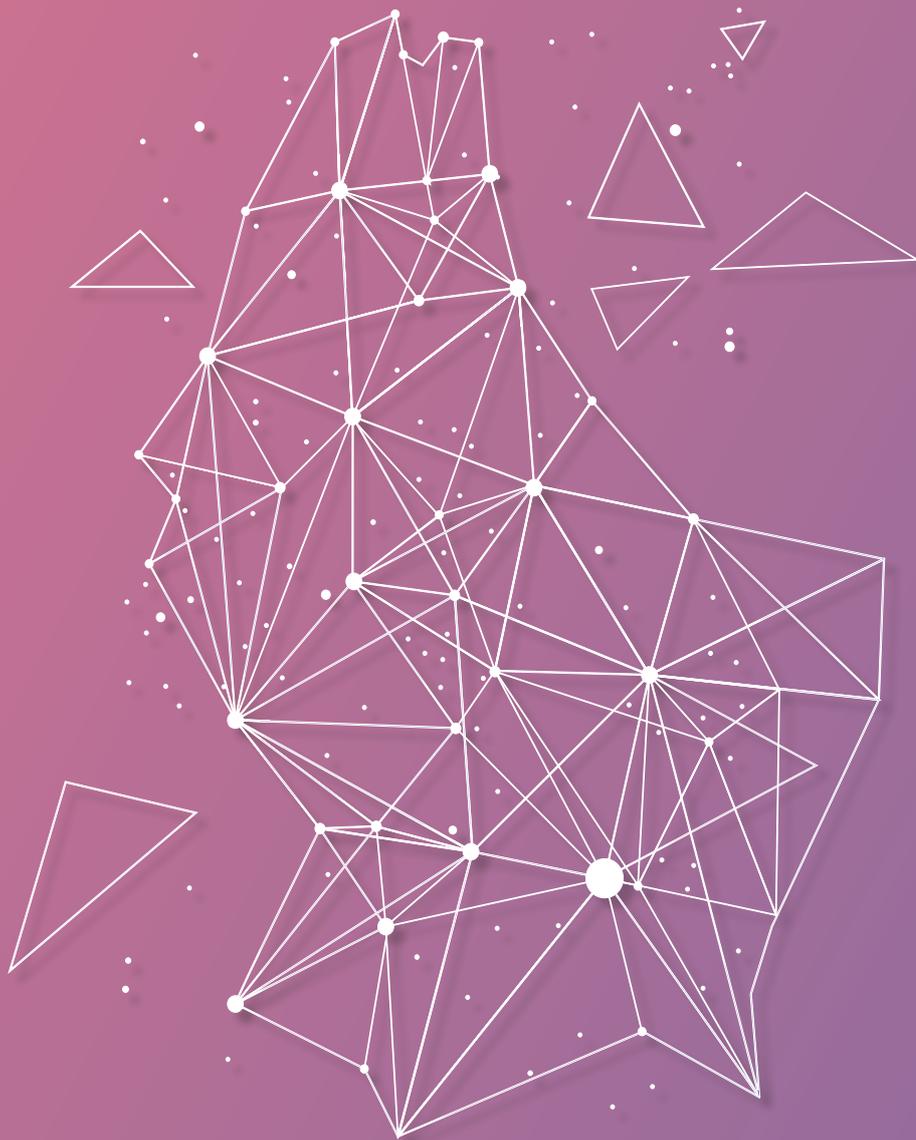


THE GOVERNMENT
OF THE GRAND DUCHY OF LUXEMBOURG



**digital
luxembourg**
innovative initiatives.

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a powerful technology,

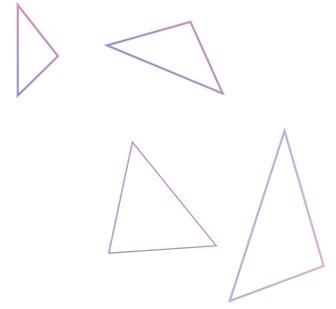
bursting with opportunity.

Artificial Intelligence is ready to be harnessed. What this means exactly is up to us.

The digital movement has brought with it unprecedented amounts of data, but it is only valuable if we can extract value from it. In a data-driven society, AI is the channel through which we can translate unfathomable amounts of data into instant, actionable answers. In other words, AI makes it possible for humanity to tap into a global, collective intelligence for the first time ever.

By automating cumbersome processes, unlocking a new level of personalized services and laying the foundation for a “smart” world, AI holds the power to transform human life like few technologies before it. Perhaps even more important than the discoveries we make is what we decide to do with our new tools and knowledge. Due to AI’s massive implications, each step forward that our country takes will be coordinated, collaborative and informed by diverse perspectives.

Luxembourg’s vision is one in which AI weaves smoothly into the fabric of society – improving the lives of all citizens and strengthening our activities as a nation and member of the global community.



This strategic vision for AI in Luxembourg articulates our activities, ambitions and intentions related to the role of AI, both here and across the EU.

For Luxembourg, committing to AI goes beyond supporting applied research and development projects. It means knowing where we can make a difference, on a global scale. And it asks us to take a good hard look at the role we want AI to fill within our society. As a diverse, innovative nation, we will decide what impact this technology will have on human rights, on people's lives and on our democratic values.

That's AI: a powerful technology fully in our control and bursting with opportunity.

Xavier Bettel
Prime Minister
Minister for Digitalization

a strategic vision for ai

in Luxembourg.



Establishing a strategic vision for AI in Luxembourg has become a national priority. The time has come to analyze recent developments, acknowledge the speed at which AI technologies deliver new services, and actively shape AI in the country. The Prime Minister and Minister of Digitalization, Xavier Bettel, has launched an inter-ministerial consultation process to define a strategic vision for AI in Luxembourg, the result of which is presented in this document. **This vision is not intended as a one-off strategy, but rather the first edition of a policy vision, to be updated on a regular basis and further defined where needed.**

This policy vision is built on Luxembourg's ambitions as a digital front-runner:

- **Ambition #1:** - *To be among the most advanced digital societies in the world, especially in the EU*
- **Ambition #2:** - *To become a data-driven and sustainable economy*
- **Ambition #3:** - *To support human-centric AI development*

It is possible that the country's opportunities to develop ground-breaking fundamental AI research are limited. Other than the financial services sector, we lack the critical mass of other countries to harvest the opportunities of large-scale datasets. This vision does not pretend otherwise. However, Luxembourg is extremely strong in focused and applied AI research and can certainly contribute to the development of services that will help us overcome big challenges. Luxembourg has the funding, the ecosystem and the infrastructure to develop this strength in the short and long term.

Every day, Luxembourg's researchers develop unique and cutting-edge technology. In Esch-Belval, AI tools are helping them sift through the medical data of Parkinson's patients. The answers may already exist, but only AI can find the needle in the large haystack of medical data. And thanks to AI-powered computing, researchers are designing and testing a new paradigm in Luxembourg's mobility: autonomous cars, which achieve levels of safety out of reach for humans. This is Luxembourg's unique advantage:

because of its strategic focus on applied AI, Luxembourg is – already today – a living AI lab with global influence.

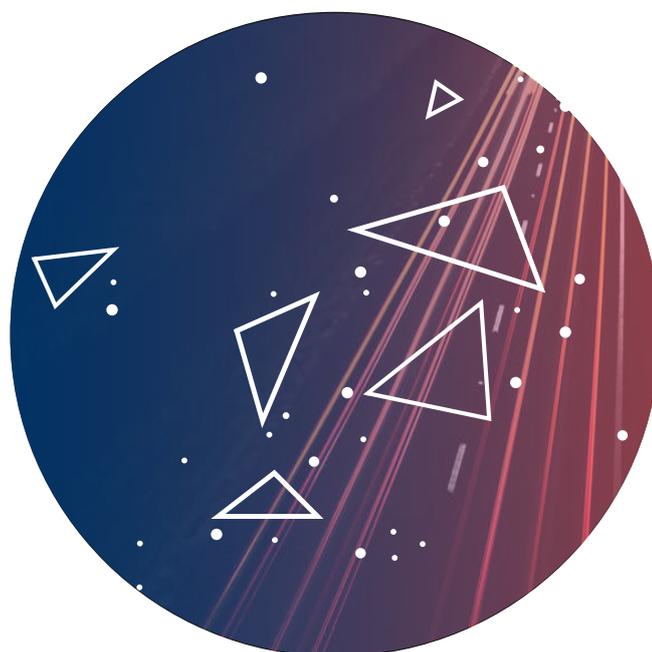
AI is fueled by very large data sets. In most areas, as mentioned, Luxembourg will not have the critical mass to generate these data sets on its own. But in order to assure that those data sets can reach their full economic and social potential, while safeguarding fundamental ethical and privacy principles, a number of regulatory questions regarding the use of these data sets have to be answered.

Therefore, Luxembourg will develop research and innovation activities focused on regulatory frameworks concerning the use of data for AI. The goal will be to shape an attractive and agile environment for data-driven and data-intensive services and activities in the field of AI.

Luxembourg is not only located between France and Germany, but it is also in close proximity to some of their most advanced AI research centers: Nancy, Strasbourg, Saarbrücken, Kaiserslautern and Freiburg, to name but a few.

Responding to those countries' respective AI strategies, Luxembourg could become part of a cutting-edge, cross-border hub for applied AI research of the highest level of excellence.

This strategic AI vision is based on an already strong financial commitment. The Ministry of the Economy has allocated approximately €62M in 2018 for AI-related projects through R&D grants, while granting a total of approximately €27M in 2017 for projects based on this type of technology. The Luxembourg National Research Fund (FNR), for example, has increasingly invested in research projects that cover big data and AI-related topics in fields ranging from Parkinson's disease to autonomous and intelligent systems – approximately €200M over the past five years. At the request of the Government, the FNR is currently revising the national research priorities for Luxembourg. The data-driven economy and AI-induced innovations in health, mobility and regulation will be part of the updated research priorities.



human-centric focus

Human intelligence - in control of AI.



Today, AI comes mainly in the form of companion technologies, which are already augmenting the diagnostic capacities of our medical staff, handling dangerous and time-consuming industrial labor, and taking care of repetitive tasks so that employees do not have to fill out endless forms, for example. The technology augments our abilities to see, read and understand complex environments in a fast and reliable way. Even though it might feel like a technology with a mind of its own, it is a reflection of our own intelligence and always in our control.

The individual should be at the center of all AI services we support in Luxembourg.

This attitude summarizes the Government's strategic vision, which is, above all, human-centric. AI could contribute up to €13.33 trillion to the global economy in 2030, more than the current output of China and India combined. Global GDP could be up to 14 percent higher in 2030 as a result of AI – equivalent to an additional €15.7 trillion – making it the biggest commercial opportunity in today's fast-changing economy.

A study from the European Commission highlights that the EU is among the geographical zones with the highest number of players active in AI (25%), just behind the United States (26%) and just ahead of China (24%). Due to its low and fragmented investment levels for AI, the EU wants to rapidly increase investment and reach a total of at least €20 billion in the period 2018-2020.

Today, the EU is not considered a global leader in AI. However, there is no reason to be shy about our achievements, as large numbers of excellent European researchers and industrial actors have been driving AI forward for decades, even while public interest ebbed and flowed. The European Commission, meanwhile, has published multiple policy documents on the subject and will further strengthen the EU's position in AI, e.g. by increasing funding budgets and identifying barriers to AI adoption. Its coordinated action plan on AI, released in December 2018 has established a number of important priorities for the EU. In addition, it has, under the leadership of the High-Level Expert Group on AI, published Ethics Guidelines for Trustworthy AI. Luxembourg's strategic AI vision was drafted with the European Commission's priorities and the Ethics Guidelines in mind.

To properly discuss AI in this document, a definition is essential, since AI has become an umbrella term comprising a number of technologies, such as robotics, automation, natural language processing, computer vision and data analytics. A number of actors also use the term machine learning to describe computer software that optimizes itself based on a set of data, often to solve relatively narrow and specific tasks. There are also concepts, such as assisted, augmented or autonomous intelligence, that describe different levels of artificial intelligence. In this strategic vision, we are defining artificial intelligence as a machine's ability to mimic human behavior and, to an extent, human intelligence. This broad spectrum encompasses single tasks (think chess playing, translating or categorizing images) and complex activities (e.g. autonomous driving). General AI will remain a topic to be monitored as technology evolves.

Human intelligence – in control of AI

Thanks to digitalization, humanity is stockpiling data at an exponential rate.

Those with the most interesting datasets – whether specific startups, industries or financial centers – will truly profit from AI's potential. Data markets are materializing, and we are seeing the rise of a data-driven economy – an opportunity for which Luxembourg's Government is extensively preparing thanks to a dedicated strategy developed at the Ministry of the Economy.

More and more, it becomes evident that AI is the liaison between data and society's most valuable products and services. With the ability to scan, identify and translate troves of information into actionable conclusions, AI lets us tap into the world's collective wisdom to solve local problems. While AI is not radically new, especially for Luxembourg's researchers, it is on the threshold of being accessible and applicable across industries and throughout society: digital health, finance, mobility, logistics, clean technologies, space and beyond – not to mention education, environment and art.

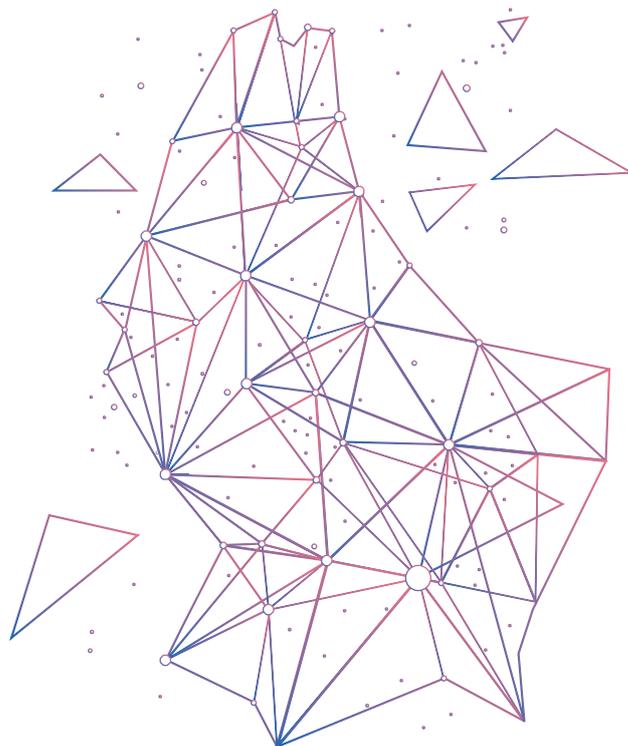
As with every high-potential technology, AI's integration will bring far-reaching consequences and some growing pains. The increasing integration of AI into existing workflows, for example, may raise new questions in terms of working conditions, employment law and labor relations that will need to be addressed by legislators in close cooperation with social partners (i.e. employer organizations and trade unions).

Challenges related to increased automation have to be considered alongside the opportunities of new jobs, which would give rise to new skill requirements and could potentially lead to a polarization of the labor market. The inclusive labor market policies pursued by the Government are thus vital in ensuring that nobody is left behind. Furthermore, data privacy and cybersecurity, already at the top of the Government's priority list, remain critical in the context of new AI services, especially given that those services partially rely on personal data.

Technology's applications should reflect the evolving desires and needs of citizens. Therefore, AI's role in society is not set in stone but will be determined along the way. Its capabilities will change – and more importantly – so will the purpose society defines for it. After all, the Government does not support digitalization and new technology for their own sake but for their capacity to improve our daily lives.

AI is not only built by people, it is built for people.

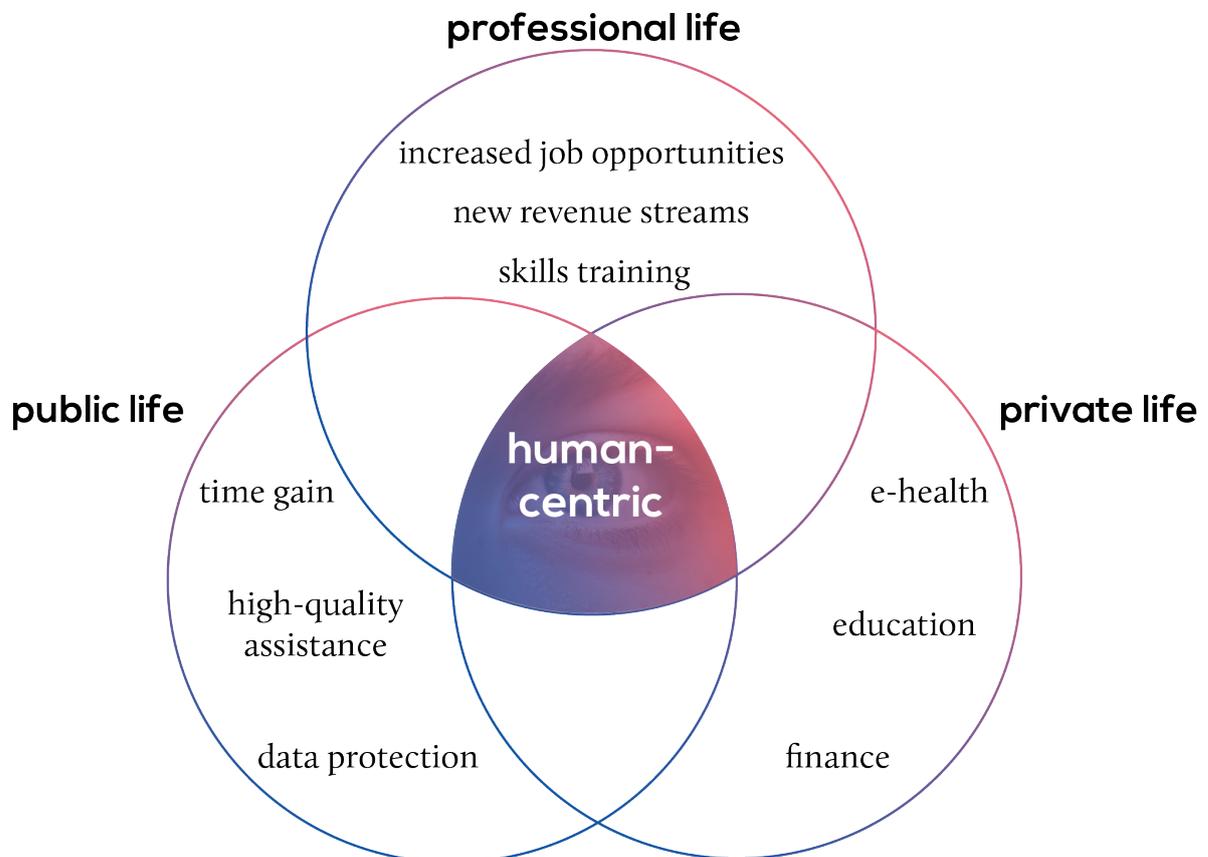
To make sure that AI can best serve them, it needs to be understandable, transparent and, ultimately, trustworthy. A human-centric approach requires a level playing field among the diverse stakeholders investing, working and living in Luxembourg – ensuring they all benefit fully from new technologies and the nation's digitalization.



Luxembourg's Government is firmly committed to fueling digitalization and high-potential technologies. This policy, however, is not an end in itself. An important consequence of digitalization is an increase in the economy's productivity. However, a purely economic goal is not sufficient. At the center point, the starting line and the end goal of all AI-related policies, you will find the individual. The Government aims to raise awareness of AI and help citizens develop a deeper understanding of it in order to transform them from merely passive consumers to active users of AI-related products, services and technologies. They should be aware of both its potential and its limitations.

With a human-centric approach, the Government will focus its actions on purposeful policies that change the lives of citizens in each sphere:

- **Private life: daily, routine activities**
- **Professional life: participation in Luxembourg's diverse economy**
- **Public life: interactions with the government and among citizens**



AI in our personal lives

AI has the potential to improve people's daily lives in a non-obtrusive and intuitive way. Individuals can benefit from AI in many scenarios: assisted living, decision-making, health diagnostics/treatments or traffic management, for example. With regard to mobility, a considerable amount of data is collected every day, while a large amount of historic data already exists. The case study below displays how embedding AI could lead to safer mobility, support traffic management or provide useful information on the most efficient modes of transportation. AI will prove to be an essential tool when it comes to smart cities and sustainable solutions as it facilitates interconnection via the information modelling techniques of applied technologies, e.g. building efficiency, waste management, energy consumption and storage, parking accessibility and availability of electric charging stations for vehicles or bikes.

Use Case: AI for Mobility

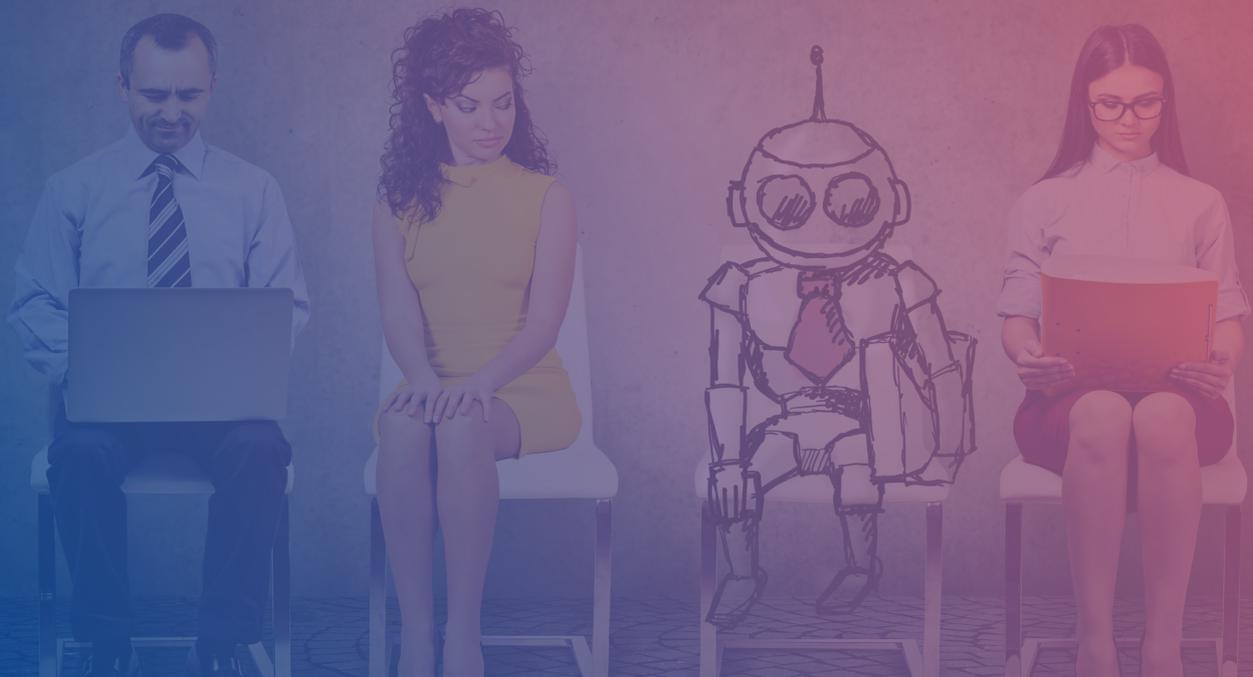
Tara and Laurence haven't met for coffee in over a week due to busy schedules, so they are thrilled to finally be meeting this weekend in the city center. The question is, how will they get there? Tara uses an AI-enabled app to guide her (avoiding routes that are congested), which uses predictive analytics to determine when she should leave in order to arrive on time. Laurence decides to ride his bike to his appointment and is happy to have such good air quality! Despite the existing transportation system, AI makes travel more efficient and personalized. And, they all arrive on time to their meeting.

AI will bring preventive healthcare to the next level, while advancing diagnosis and treatment procedures, for instance in oncology. The healthcare industry will experience boosted efficiency, real-time analysis, predictability and quality care. Personalized medicine is a major priority for Luxembourg. In the context of its aging population, the country's health institutions and healthcare providers need to leverage the new possibilities in preventive healthcare and map diseases to their advantage. This will be a priority of the new e-health strategy being prepared by the Ministry of Health.

Use case: AI for Health

You have been feeling sick for days and it is only getting worse. You visit your doctor and, although he or she is not immediately sure how to help, a quick global search of your symptoms reveals a similar case in Southeast Asia. More detailed tests reaffirm the suspicion and within a few hours, you begin your personalized treatment, which successfully provides relief. Every year, hundreds of thousands of medical research papers, case studies and articles are released in dozens of languages all over the world, bringing a wealth of knowledge. AI-powered search engines make that knowledge accessible to you and your doctor, improving diagnoses and treatment.

All industries and the people they serve will benefit from tailor-made advising, products and services. Luxembourg's public research actors are actively involved in developing state-of-the-art technologies, paving the way for smart cities and the technological applications that go with it (smart connectivity, smart mobility, smart health, smart living, etc.) to improve urban life through integrated and sustainable solutions.



AI in our professional life

AI can be an extraordinary source of relief for professionals. AI's strength is its ability to analyze large amounts of data in no time. So, it can carry out data-heavy work, while allowing humans to focus on their strengths: social relations, emotional intelligence, creativity and cultural sensitivity.

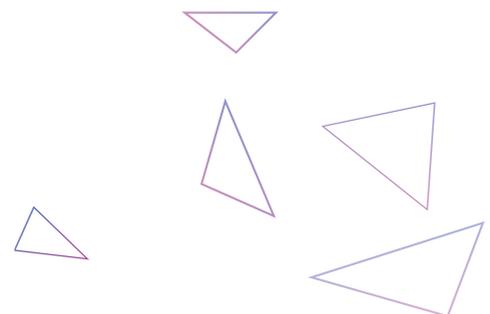
In this context, when humans and AI join forces, they enhance their complementary strengths, scaling up each other's advantages.

At the same time, the increasing integration of AI into existing workflows may raise new questions in terms of the working conditions, employment law and labor relations that will need to be addressed by the legislator in close cooperation with social partners (e.g. employer organizations and trade unions).

Use case: AI for Employment

It is March: your company's busiest month. Several years ago, this meant you were not able to leave the office before 10pm, buried in towers of documents, racing against the clock. But all that changed when your company started leveraging AI tools that sift through hundreds of documents per second and present you with only the documents that require a second glance, and then help you make the right decisions. You are done by 6:30pm and are even complimented for the quality of your work. For many, their workloads keeps increasing, reducing the quality of their output. AI-powered tools can improve the way you work and eliminate unnecessarily stressful situations.

AI will impact both repetitive administrative tasks and major intellectual challenges. Without a doubt, it could be an excellent tool in cognitive tasks – such as analyzing and reading legal texts or translating, via natural language processing tools. AI will not just affect low-skill, basic tasks, but also skill-intensive jobs. In the medical sphere, specialists are already discussing how to implement AI applications to help define precise blood tests or improve diagnosis consensus.



Use case: AI for Networking

Identifying and tapping into professional opportunities takes patience and perseverance and, most importantly, some form of guidance from a professional. Building your professional network with targeted suggestions thanks to career AI tutors would have seemed surreal a few years ago – but welcome to reality.

Your entrepreneurial profile, past experiences and AI-driven personality analytics enables you to receive personalized recommendations and build a network that aligns with your professional goals.

In the domain of education, AI could help in defining and generating personalized teaching/learning methods and tools, especially in the field of differentiated education.

AI could also simplify internal businesses processes (e.g. in companies or hospitals) regarding B2B exchanges or automatized internal communication procedures.

This evolution requires re- or up-skilling of the workforce, which hinges upon the commitment of both public and private institutions. Employees and civil servants will need training and lifelong learning that imparts an understanding of AI analysis, applications, general functioning and implications. The Luxembourgish Government already launched the Digital Skills Bridge initiative, which aims to assist the private sector, not just in re-skilling its workforce, but also in acquiring the digital expertise to integrate digital products & services.

Use case: AI for Government Services

You have just arrived in Luxembourg and cannot wait to start your new career. You go to your commune's office at 8am to register as a resident and provide all necessary information. In your first six years of residency you find that you do not need to provide any further information or waste time filling out forms since the data is already saved thanks to AI-powered tools. You're able to build a positive relationship with Jill, who works at the commune, because your meetings are centered on meaningful discussions rather than the completion of redundant tasks, such as filling out administrative documents. And, guess what? There's no queue.

On the other hand, Jill does not waste time asking for the same information or digging around for details. AI-powered tools and intelligent software bots help her excel in her position and allocate time to making real connections, leaving her more fulfilled at work.

AI for citizens

AI has the potential to simplify citizen-government interactions. Society will benefit from access to improved, personalized public services, which will result in time-saving, increased transparency and more customer-oriented services.

In the process of administrative simplification, public administrations could utilize AI-based new technologies to offer more efficient and qualitative services to citizens living and working in Luxembourg. The Government supports the Digital by Default principle, so it goes without saying that more and more procedures will be digitalized. A concrete example is the Guichet.lu portal, which is an online administrative website. Through a chatbot engine or other AI applications, the Guichet.lu portal could boost efficiency and offer tailored and responsive services.

When talking about AI, there is no way around the topic of data. In 2016, Luxembourg's Government launched the Data.Public.lu portal – an open data gateway to public services that freely provides over 200 national datasets from different fields: environment, public health, geo-spatial, traffic and statistics. The portal is a valuable, transparent tool, not just for citizens, but also for industries that want to develop digital applications.

Use case: AI for Civic Engagement

The World Health Organization estimates that 15 percent of people worldwide have some form of impairment that could lead to disability. Sophia is a 24-year-old citizen who loves politics and social activities but cannot speak or walk due to cerebral palsy. To support Sophia in her political endeavours, AI-powered solutions with voice-control capabilities are being developed to ensure that she can take part in political discussions and be heard. AI-powered tools for people with disabilities can make a meaningful difference in their ability to participate in all aspects of daily life.

Last but not least, digitalization and AI bring with them significant opportunities and challenges that must be discussed and clarified before new technologies are fully embraced by citizens. The Government of Luxembourg remains accountable and transparent in its applications of AI and digital tools. Its digital inclusion efforts aim to simplify public administration services and demystify the complexity of new digital applications by bringing them closer to citizens.

ai in luxembourg - where do we stand?

Regional cluster of AI research excellence.



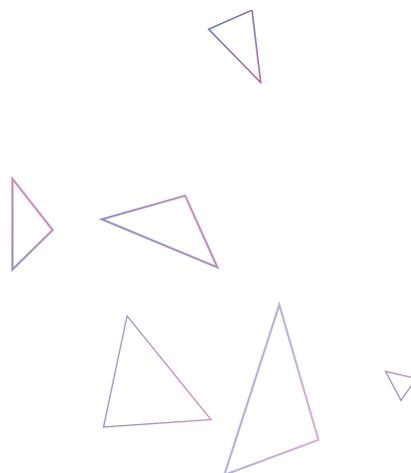
In recent years, Luxembourg's research community – hosted by the University and the public research centers LIH (Luxembourg Institute of Health), LISER (Luxembourg Institute of Socio-Economic Research) and LIST (Luxembourg Institute of Science and Technology) – has grown rapidly, representing solid, diverse deep learning expertise. At SnT (Interdisciplinary Centre for Security and Trust), for example, 40 percent of the research projects are related to AI. However, AI is not just present in academia. The National Health Laboratory, for instance, is already using a new AI informatics tool that can diagnose brain tumors based on a molecular marker, thus advancing their diagnosis capacity.

Or, consider the global success story that is Talkwalker, a social listening company founded in Luxembourg that relies heavily on various AI technologies. At the same time, larger industrial actors like SES, Husky or Goodyear have started to use deep learning tools in their research and operational processes. Startups that focus entirely on AI-based services or products have also sprung up: e.g. AIVA, Tetrao, DataThings and LuxAI. There's no doubt that Luxembourg's AI ecosystem is alive and well.

A number of international partnerships have been set up in Luxembourg to foster the ecosystem's potential. They not only help Luxembourg's AI actors gain international visibility but open up access to cutting-edge resources. If anything can make or break the arrival of innovation, it is access to advanced technology.

Regional cluster of AI research excellence

Luxembourg and the Greater Region lie in close geographical proximity to a number of AI research centers that share an exceptional level of excellence, e.g. INRIA in Nancy, DFKI and the Helmholtz-Institut in Saarbrücken. This high density of AI research leaders is unique in Europe. Luxembourg is strongly in favor of increasing collaborations between German, French and Luxembourgish institutions by creating a new kind of research cluster dedicated to joint bids for international calls and multi-disciplinary research and relying on critical mass of AI research. This virtual regional cluster would respond to calls from German and French national AI strategy teams, building a strong Franco-German cooperation in high-quality AI research.





focus area

A human-centric approach requires us to consciously decide how to best integrate AI into our personal and professional lives, as well as into our activities as citizens. Having developed the **why**, we shall now move onto the **how** of this strategic AI vision. Luxembourg's Government agrees to work on the following focus areas:

1. Luxembourg as a living laboratory for applied AI

Luxembourg understands the importance of transferring research findings to the real world. Its R&D investments largely focus on applied research with international multidisciplinary centers of excellence, emphasizing on biology, cybersecurity, networking and trust. Luxembourg bridges fundamental research and new market applications by experimenting and testing state-of-the-art technology in real-world environments, becoming a living laboratory for tomorrow's innovation. To this end, the FNR supports several initiatives to enhance technology sharing, provides researchers with the opportunity to develop and commercialize their research and encourages the creation of research-based spinoffs (as it did with LuxAI, for example).

In order to reap the benefits of research results, Luxembourg will focus on the following key actions:

- *Prioritizing personalized medicine, which relies heavily on AI-related technologies, in the new e-Health strategy under preparation by the Ministry of Health. In the context of its aging and growing population, the country's health institutions and healthcare providers need to take advantage of the new possibilities in preventive healthcare, diagnosis and the treatment of diseases.*
- *Establishing world-reference testing facilities with other Member States while optimizing investments and avoiding redundancies. Examples of such collaborations include Luxembourg, Germany and France testing connected and autonomous mobility on the first European cross-border experimental site in Schengen, as well as the establishment of Luxembourg as a health data hub in biomedicine and personalized medicine. In the financial services industry, with its wealth of international/cross-border datasets with potential commercial value for a number of industries, Luxembourg is an attractive option for cutting-edge technology developers.*
- *Studying the feasibility of regulatory sandboxes to develop frameworks that can support Luxembourg's role as a leading living laboratory (cf. 5 – Ethics and Regulation).*

- *Stimulating activities related to applied research, the funding of AI products and services from relevant actors in the ecosystem (i.e. startups, SMEs) via initiatives such as Luxinnovation's Digital Innovation Hub.*
- *Mapping of skills and expertise in the Luxembourg research ecosystem, as well as AI-related companies.*

2. Data: The cornerstone of AI

In recent years, Luxembourg has demonstrated its commitment to building and consolidating large European data lakes to facilitate research-enabled solutions for society. A key initiative is the National Centre for Excellence in Research on Parkinson's Disease. It represents a joint effort between four research partners in Luxembourg that brings together their Parkinson's disease expertise.

Within Luxembourg's advanced open data portal, public and private actors can share datasets to enable AI-based services for researchers as well as public and private actors by sharing datasets. This strategic AI vision is an opportunity to revisit and scale up the open data policy. As a long-term strategy, Luxembourg will focus on enabling access to high-quality data and interoperable forms for researchers and companies to build and program their AI applications. This is in line with the Ministry of the Economy's Data-driven Innovation Strategy that develops a catalogue of action points in order to support new data-driven business models in economic sectors of high priority, namely industry 4.0, logistic, eco-technologies, healthtech, financial services and space innovation.

In order to ensure that data remains an asset to AI, Luxembourg will focus on the following key actions:

- *Identifying innovative regulation in the context of data marketplaces in order to increase legal certainty and transparency of data economy participants.*
- *Relaunching the government's open data policy with a new roadmap, taking into account the public sector's crucial role as a data provider for AI services development.*
- *Working on projects to enhance quality and accessibility of data by supporting the development of data infrastructure. This infrastructure should enable the management and sharing of data in real time and experimentation through a sandbox of data-driven AI-powered services, together with blockchain-based solutions for data integrity.*
- *Creating an innovative and trusted regulatory environment in order to attract data-driven and data-centric services and businesses to Luxembourg. (cf. also point 3 on Ethics & Regulations)*

3. Ethics, privacy regulation & security

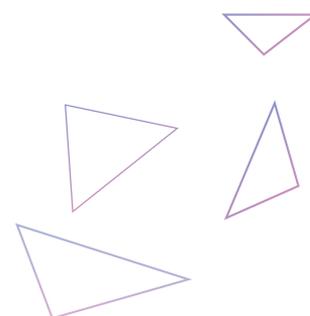
Exploring the links between privacy regulations, ethics, security and AI is crucial. AI applications that meet high standards of transparency will become essential to innovation. Given the strategic importance and high complexity of this topic, Luxembourg is keen to invest in an enhanced AI-friendly framework. This means looking at new regulation that can enable a functioning data marketplace, for example, in order to remove barriers to secure AI development.

In addition, Luxembourg will promote the Ethics Guidelines for Trustworthy AI released by the Commission's High-Level Expert Group on artificial intelligence. Investments are needed in the development of effective human-AI collaboration; humane and ethical automation and AI; and the legal and societal implications of these technologies. In each case, public research, funded partially by the FNR, can counterbalance private applied research, which may not always prioritize social good.

Digital Luxembourg, the government initiative charged with unifying and strengthening the nation's digitalization efforts, supports a number of projects that contribute to Luxembourg's AI ecosystem and could support similar non-profit organizations dedicated to AI.

In order to ensure that legal and ethical guidelines are implemented to protect fundamental rights and freedoms, Luxembourg will focus on the following key actions:

- *Engaging with the national data protection authority and leveraging its expertise in order to address AI-related questions.*
- *Setting up a governmental technology & ethics advisory committee to discuss ethical implementations of technology and advising the Government on potential risks and societal impacts.*
- *Collaborating with key bodies that work on developing and safeguarding corporate governance in Luxembourg to accelerate the adoption of proper AI corporate governance.*
- *Actively following, under the leadership of ILNAS, international normalization processes in the field of AI, for example in the context of ISO.*
- *Developing and implementing innovative privacy-enhancing technologies for the use of large datasets in the context of AI learning.*



4. Boosting investments & developing strategic partnerships

Luxembourg has been investing heavily in international connectivity, ICT infrastructure and innovative projects for the past 15 years, often engaging in strategic partnerships. The Luxembourg Commercial Internet eXchange (LU-CIX), for example, encompasses a network of six data centers – the groundwork for high-speed, high-volume data transfers, blockchain initiatives and cybersecurity initiatives, ensuring new public investments in RDI and AI infrastructure. Likewise, Luxembourg's High Performance Computing (HPC) initiative strives to open up access to expensive computing resources and expertise to a broad range of actors, thus lowering the barriers to entry for AI-based products and services by mutualizing costs and pooling scarce skills.

With these long-term investments, Luxembourg has paved the way for the integration of the most cutting-edge technologies. Its early actions have grown into excellent infrastructure, unparalleled on a national level and have already attracted global tech players to invest in our local ecosystem. On the R&D side, the National Research Fund (FNR) funds project collaborations between researchers and companies in Luxembourg, supporting public-private research on topics like advanced robotics, digital manufacturing, improved design tools and enhanced perceptual capabilities in AI systems.

In order to remain a leader in AI partnership investments, Luxembourg will focus on the following key actions:

- *Deploying and promoting the HPC initiative as a fundamental instrument in tomorrow's AI economy.*
- *Spearheading the timely implementation of the EuroHPC initiative in order to develop a pan-European supercomputing infrastructure.*
- *Ensuring synergies between new public investments in RDI and infrastructures related to AI activities – for instance, by launching initiatives similar to the 5G pilot zones that will be emerging in Luxembourg over the next years. 5G will enable connectivity in all domains of life, such as home, automotive, health, industrial production and much more.*
- *Developing new partnerships in the field of AI with leading firms in different disciplines to grow the number of AI solutions and skills accessible to Luxembourg's ecosystem. A chief example of this is the ongoing partnership with NVIDIA, which has led to the creation of a joint AI laboratory in Luxembourg. Connecting Luxembourg with relevant AI solutions, as well as identifying and insourcing technology and service providers from abroad will become crucial for the local industry. Such efforts are also being undertaken by the Luxembourg House of Financial Technology (LHoFT) and Luxembourg for Finance, in the context of financial services, for example.*



- *Financing a portfolio of innovative AI companies by leveraging existing investment funds and financials resources, such as The Future Fund, Digital Tech Fund and the Société Nationale de Crédit et d'Investissement (SNCI) bank.*
- *Unlocking private investments through new incentive mechanisms, such as the creation of AI technology development opportunities. Through PPPs, the Government will be able to better identify and prioritize multidisciplinary issues that could have a high impact on Luxembourg's economy and society.*

5. AI for the public sector

AI-enabled solutions can contribute to better public services in a variety of ways. They become particularly obvious in citizens' interactions with public authorities by providing improved, tailored public services. Luxembourg has already invested in key government initiatives related to eGovernment and multilingual solutions that serve as the groundwork for future AI applications. AI-supported public services result in enhanced accessibility and 24/7 availability. This will involve investments in AI projects that provide better, cheaper and faster public services while also stimulating positive social impacts. What's more, improved government services strongly benefit SMEs, who lose less time with paperwork and delays.

In order to ensure that citizens and administrations harness the benefits of AI-enabled solutions, Luxembourg will focus on the following key actions:

- *Developing a comprehensive overview of potential projects based on criteria, such as feasibility, necessity and value to create human-centric AI solutions for citizens.*
- *Engaging with other EU member states in peer-learning while also taking into account the exchange of best practices, experience and data.*
- *Contributing to the development of AI solutions in order to build more efficient and personalized public administration services that serve all parts of society.*
- *Supporting Digital by Default with AI tools that can ease its implementation, reinforce customer-oriented services, and provide tailor-made and integrative products/services to better engage Luxembourg's diverse, multilingual and multicultural society.*
- *Fostering research and innovation that assess AI systems for the public sector; developing expertise combined with civicttech applications and disseminating results and questions to the public.*
- *Studying the creation of a structured public database ecosystem aimed at eliminating technical barriers for AI use cases.*

6. Skills & lifelong learning

In the past 10 years, Luxembourg has attracted excellent researchers and talent to build a proper foundation for AI expertise. The increased use of AI in professional environments requires the anticipation of future skills and, once identified, a strong investment in upskilling programs. Lifelong learning programs will need to be strengthened and specific digital and AI-related training programs will need to be offered to allow firms, employees and the unemployed to successfully adapt to a changing labor market. In spring 2018, the Government launched a pilot project - the Luxembourg Digital Skills Bridge - that addresses leading challenges. Luxembourg has also focused on sharing best practices regarding how to reinforce excellence, retain AI talent in Europe and attract more women to AI studies.

In order to ensure that no one is excluded and that sufficient resources are invested into skills and lifelong learning, Luxembourg will focus on the following key actions:

- *Developing digital training modules for the general public, providing an introduction to AI and fostering a basic understanding of the technology, its opportunities and its risks.*
- *Developing AI-enhanced learning environments in order to provide a tailor-made and adaptive learning experience.*
- *Including AI skills in the Government's talent attraction strategy.*
- *Mapping the national education offer, ensuring that AI is integrated into other disciplines, such as law, business, human sciences, environment and health.*
- *Assessing the future needs of AI-related skills required by private- and public-sector actors.*
- *Adapting and expanding Luxembourg's Digital Skills Bridge to the new future needs of the economy in order to upskill the current workforce.*
- *Developing new AI training in collaboration with private sector technology leaders.*
- *Exploring how AI could be incorporated into the curricula of secondary and postsecondary education, including vocational training.*

7. International cooperation

AI is currently a topic of discussion across the globe. The development and use of AI can benefit from international and regional cooperation. Luxembourg has a long-standing tradition of actively participating in new EU initiatives and reiterates its commitment to investing in EU AI-related collaborations. Given the increasing importance of the Greater Region (four countries encompassing 11 million inhabitants), key cross-regional initiatives will be launched to solve regional issues, such as employment, mobility and health, through AI collaborations.

Likewise, the new 2030 general development cooperation strategy focuses on a multi-stakeholder partnership approach (cf. the 2030 agenda for sustainable development goals). This will allow knowledge transfers on AI-solutions to contribute to the eradication of extreme poverty and promote sustainability.

In order to ensure international and regional cooperation on AI-related initiatives and activities, Luxembourg will focus on the following key actions:

- *Actively supporting high-quality networks of European AI research centers, such as the Confederation of Laboratories for Artificial Intelligence Research in Europe (CLAIRE).*
- *Taking part in key community and cross-border initiatives, such as AI-powered Earth observation (Copernicus project) or the development of a common database of health images initially dedicated to the most common forms of cancer.*
- *Analyzing the opportunity and feasibility of sharing and building AI expertise in “strategic development cooperation” countries.*
- *Learning best-practices from other countries that have mature AI-related projects and establishing research-based collaborations.*
- *Actively promoting and adopting international standards in the field of open data and facilitating interoperability between data catalogues, such as the Data Catalogue Vocabulary Application Profile for data portals in Europe.*
- *Actively adopting and contributing to open source tools and frameworks for the implementation of AI solutions and projects.*



The Government's agreement on this human-centric approach to AI is just the first step. In order to put it into practice, a governance mechanism is needed to continuously follow up on strategic initiatives that support Luxembourg's AI development.

Governance

An inter-ministerial coordination group, under the leadership of the prime minister, will regularly assess the strategic vision. Assuming AI remains on the agenda for years to come, this strategic vision should be seen as a framework for action and a starting point for new policies, rather than a one-off action plan.

In order to feed the Government with expert opinions on current developments, an advisory committee composed of experts from the fields of science, technology, legal matters, social impact, ethics and humanities will advise the Government on the implementation of projects and actions resulting from this AI vision, as well as on the consultation process.

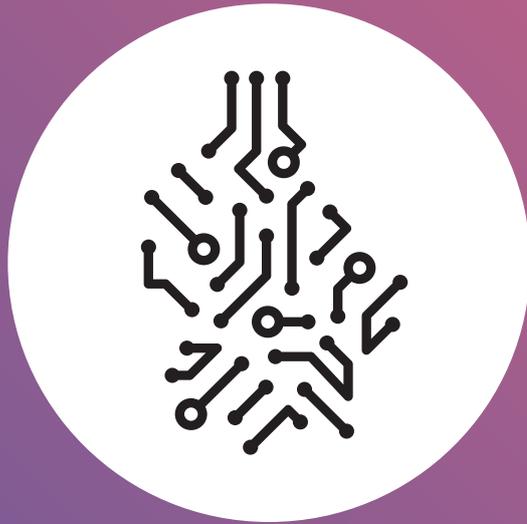
Public consultation on AI policy

The current public discussion on AI reveals significant opportunities and a number of risks, some of which are already addressed in this strategic vision. The process of digitalization as a whole, and the rollout of AI into everyday life are stories yet to be written. That is why the Government plans to consult the public regarding AI – collecting all perspectives. It will begin by launching a public consultation in Q3 of 2019. This will be done in a welcoming, simple manner through different methods, taking into account the digital divide. The second step involves evaluating the consultation, possibly via focus group discussions with members of the public. This public consultation will provide the Government with society's opinions on AI, which it will strive to integrate into its policy making.



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