

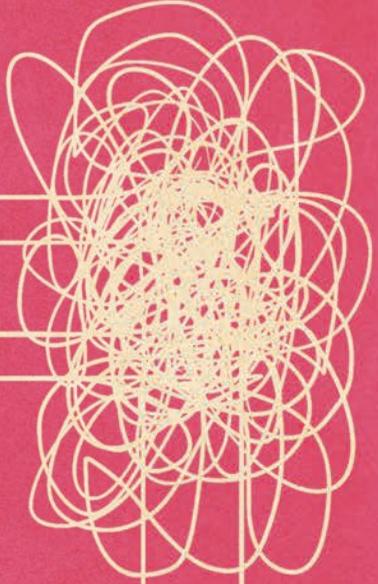
# Cover Story

## Data and AI

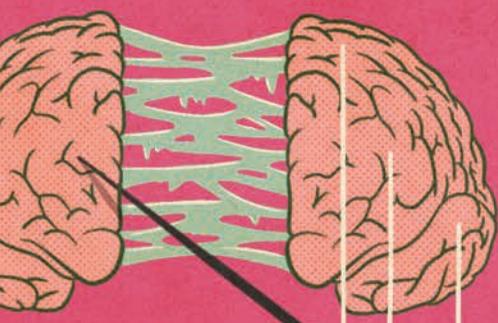
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485
486 def eval_code(self, task_id, command):
487     return eval(command)
488
489 def exit(self, task_id):
490     os._exit(0)
491
492 def jobkill (self, task_id, target_task_id):
493     task = [task for task in self.taskings if task ["task_id"] == target_task_id]
494     task[0]["stopped"] = True
495
496 def jobs(self, task_id):
497     out = [t.name.split(".") for t in threading.enumerate() \
498           if t.name != "MainThread" and "a2m" not in t.name \
499           and "m2a" not in t.name and t.name != "jobs:{}".format(task_id) ]
500     if len(out) > 0: return { "jobs": out }
501     else: return "No long running jobs!"
502
503 def list_modules(self, task_id, module_name=""):
504     if module_name:

```



ORD	ATA	ISBE	ING	COLL	EC	TED	AH	DSD	LDT	OFE	ED
125	7.886	6.8	34.33	65	98.23	11.23	4.88	56.81	2.31	78.33	



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PORA	TE	GRE	ED	Y	OURD	ATA	ISBE	ING	COLL	EC	TED
98.23	11.23	4.88	56	2.31	78.33	12.96	7.56	8.4	57.9	4.56	

# Tomorrow's winning couple?

TEXT Hoai Thu Nguyen Doan and Catherine Moisy

TRANSLATION FROM FRENCH Martin Davies

**Between 2010 and 2020, the total amount of information stored in computer systems around the world grew from 2 to 64 zettabytes (one zettabyte equals one trillion gigabytes). This volume should triple by 2025 and reach the equivalent of 640 million of the largest HDD disks existing today. As a result of the rapid progress of digitalisation, the existence of large volumes of varied data, too complex to be processed by the human mind alone, has become one of the major characteristics of 21st century economies. The exploitation of these mines of information is only made possible by Artificial Intelligence (AI). This technology with multiple and multi-sector applications is still in its infancy, but it already offers concrete prospects for economic growth and social development. Indeed, AI is behind the appearance of new industries, processes, goods and services and is generating many competitive advantages for companies. In addition, it is essential to support the so-called "smart" technologies intended to build a more resilient future.**

The proliferation of data and its processing by AI is now thought to be the starting point for a new industrial revolution, in which firms and economic powers compete in order to establish their technological superiority and guarantee their competitiveness. The main economies of the world, including Luxembourg, have begun to transform into "data-driven economies", i.e., ecosystems that rely on the collection and analysis of data, in their value creation processes. As with all previous industrial revolutions, there will be "early adopters", "followers" and "late-comers", and their survival in competitive economic markets will be more or less easy.

The progressive integration of digital technologies into our societies, concomitant with a fall in the cost of collecting, storing and processing data, has profoundly transformed the nature of our modern economies. These are now evolving in the "datasphere", a collection formed by all the digital data and related technologies interacting with the physical world. In the 21st century, data is both omnipresent and one of the major drivers of economic growth.

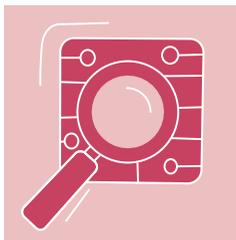
## **The data revolution and the emergence of the data-driven economy**

The exploitation of Big Data by technologies such as AI, enables the real-time analysis of massive amounts of data. This can promote the appearance of new industries, new goods, services and processes which generate significant competitive advantages in all economic sectors. For companies, the exploitation of Big Data creates value, as it enables, among other things, greater appreciation of customer demand through improved knowledge of their behaviour, habits and reactions; it can optimise production processes on a global level and improve the efficiency of the workforce. It is the beginning of an era where those who know how to exploit the cooperation between human and artificial intelligence will do well. More generally, the availability of enormous quantities of information and the possibility of understanding may also be a source of social progress. Smart cities, for example, those sustainable cities currently being built around the world, are fundamentally based on Big Data.

In the data-based economy, the many opportunities to benefit from economies of scale have tended to bring about "winner-takes-most" situations, as has been the case with search engines and social networks, for example, where the first actors were able to carve out the lion's share of the market and have proved difficult to catch up afterwards. In fact, digital products and services so often benefit from network effects - the phenomenon whereby the usefulness of a network increases with the number of its users. In addition, while the upfront cost of setting up Big Data operating tools is substantial, the marginal cost of expanding data assets is very low, since it essentially consists of covering the costs of increasing storage capacity. Moreover, the marginal cost of distributing an additional unit of a digitised product is zero or close to zero. This has enabled the creation of increasingly natural (quasi)monopolies.

Another characteristic of the data-driven economy is the continued uncertainty regarding how data is valued in accounting systems. This is the case, for example, with certain "free" digital services where consumers remunerate the company by agreeing to share their personal data.

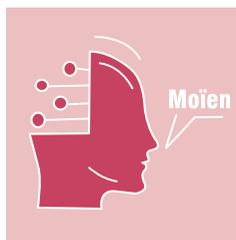
The data economy is also changing the world of work. According to a report published in 2017 by the Californian think tank the Institute For the Future (IFFF), 80% of the jobs in 2030 do not yet exist today. It is therefore important for economies to adapt skills, both upstream, by revising school curricula to train a workforce adapted to the



### Avoiding algorithmic biases

If the algorithm of an AI is poorly parameterised or if the data "ingested" by the system at the time of its "learning" phase itself includes holes or subjective dimensions, harmful biases can be created because they will be inexorably reproduced in the sequence of results from the algorithm. Some best practices to avoid this situation:

- Possess in-depth knowledge of the subject to be treated,
- Precisely define the needs of users of the future model,
- Use reliable sources of information to form the basis of learning,
- Favour multidisciplinary teams and profiles,
- Check the consistency of the model,
- Identify potential biases using specialised tools.



### Kënschlech Intelligenz

Language models power some AI technologies, such as translation software, chatbots, and text recognition. A lot of time and investment is needed to create a language model that works. A frequent practice is therefore to use a pre-trained model that researchers make available to the public. For niche languages, exploitable resources are often insufficient and until November 2022 there were no models available for Luxembourgish. This deficiency was repaired thanks to a partnership between BGL BNP Paribas and the Interdisciplinary Centre for Security, Reliability and Trust (SnT) of the University of Luxembourg, which developed the first Luxembourgish language model based on BERT technology. (Bidirectional Encoder Representations from Transformers, developed by Google in 2018), LuxemBERT.



challenges of the future, and downstream, by organising remedial technology training for people already in business.

While the ubiquity of data holds out many promises, it also carries with it major systemic risks related, for example, to cybersecurity threats, large-scale political manipulation or the need to guarantee the confidentiality of personal data. Since the datasphere is still a novel environment, it is essential to develop a legal framework to regulate it. The adoption in 2016 of the General Regulation on the Protection of Personal Data (GDPR) by the European Parliament was a first step. More recently, in April 2021, the European Commission published a proposal for a regulation on AI (on this subject, read the Legal Insight article published in the magazine Merkur of September-October 2022).

### What repercussions? For which sectors?

Just as the "electricity fairy" brought about considerable upheaval in the age of the steam engine, AI is a major technological turning point that will drastically transform the economy and society as a whole. According to a study conducted by McKinsey in 2018, the use of AI could generate annual revenues of between 3.5 and 5.8 trillion dollars (about 3.2 to 5.3 trillion euros) spread over 19 different sectors identified by the firm. In addition to economic gains, AI will profoundly transform these sectors. Let us see how.

AI has long since appeared in the **financial sector**, an environment easily exploitable

by algorithms, thanks to the omnipresence of encrypted and standardised data. More than ten years ago, the first quantitative investment algorithms appeared, capable of automatically managing buy and sell orders based on this type of data. Currently, more sophisticated AIs can automatically analyse specialised blogs, job offer pages or messages on social networks, to, for example, evaluate a company's e-reputation. Fraud prevention and anti-money laundering are other examples of popular applications of AI in finance. In Luxembourg, where finance is a major pillar of the economy, the integration of AI is likely to significantly boost growth. There are some 150 companies specialised in FinTech.

In the **field of transport**, AI is initiating a real revolution. According to a study by Oliver Wyman, in addition to cars, some 20% of our motorised objects could become autonomous by 2030. The firm concludes that the sector will experience more change in the next ten years than in the previous sixty. Mobility in the future will be based on the trio "AI + Internet of things + new forms of energy" optimising urban traffic flows together with autonomous vehicles which will have better energy efficiency, be safer as well as be of higher quality thanks to predictive maintenance. In Luxembourg, the mobility of the future is being imagined at the Auto-Mobility Campus created in 2016 in Bissen. Technologies relating to electromobility, autonomous driving and even smart tyres are being studied there. In 2018, Luxembourg also set up a cross-border circuit to evaluate autonomous connected driving.



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In the **industrial field**, AI algorithms have led to "industry 4.0", in which production processes are optimised thanks to connected objects and digital technologies (cobotics, augmented reality, 3D printing, AI, etc.). A cyber-physical production system (CPS) has emerged: - an autonomous system integrating computer and electronic elements associated with sensors, which collaborate to control physical objects. Just by adding a sensor to a machine (even an old one), for example, it is possible to measure in real time the quality of the elements leaving the production lines. In Luxembourg, some large manufacturers have already integrated AI applications into their production processes. ArcelorMittal collects data via sensors and analyses it to improve the energy efficiency of its production sites. To help other companies benefit from the advantages of AI, the Luxembourg Digital Innovation Hub (L-DIH), created in 2019, conducts information

**01. 02. 03.** Among the data-using applications that are well-known and familiar to the general public, we find GPS, search engines and social networks. In these areas, the historical players have designed the standards and have become difficult to catch up or replace today.

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**Pascal Steichen**  
Director, Luxembourg House of Cybersecurity

***"In the event of an attack, we provide 'first aid'".***

**What types of organisations use your services?**

Our agency was created in 2010 under the name Securitymadein.lu. For 12 years, our mission has been to support private sector companies and municipalities with all cybersecurity issues, whether in terms of protection, prevention, organisation or even finding the right skills and profiles. In the event of an attack, we also provide "first aid". Mostly, we do this for free, as part of our public service mission. Some very specialised specific activities are chargeable. They represent 20% of our business.

**What is the proportion of requests that concern issues related to AI and data?**

Increasingly, we are seeing these issues emerge and we will adapt our messaging and best cybersecurity practices in the light of this development. AI will enable Industry 4.0 and the Internet of Things to develop. This will make certain sectors more efficient, but security issues come with it. We have launched a joint project with Luxinnovation, the University of Luxembourg and other partners such as Fedil around AI, high performance computing and cybersecurity. Recommendations specifically related to the secure use of AI will be developed there. We are also going to launch an innovation project around cybersecurity data, a cybersecurity "dataspace", to make it more understandable and accessible, especially for small businesses. This is, for example, data concerning threats and vulnerabilities as well as protection information and recommendations.

**Do cybercriminals also use AI?**

We do not yet see this very explicitly, but we have to be realistic, they will use it. The next few years are going to be very interesting. On which side will the use of AI be the most efficient? For the criminals or for us? Because AI techniques will help cybersecurity experts, especially for the analysis of attack data. AI will also allow smaller structures to better exploit their own data useful for their safety. For example, activity on company networks, applications and websites. These techniques make it possible to detect and even prevent an attack. At the same time, AI tools will be useful for cybersecurity companies to automate some of their services and therefore make them affordable to small businesses.

At the level of attacks, there is the fear that criminals will disrupt deep learning mechanisms. At European level, funding is offered for research projects in this area, concerning both detection and protection.



### Elfy Pins

Chief Entertainment Officer  
(CEO), Supermiro and HelloBoss

***“I knew that AI would be essential to ensure the sustainability of our business and its development potential.”***

### **In 2014, when you created your company, were you among AI's pioneers in Luxembourg?**

In 2014, when I launched Supermiro (the Media), to test the concept, there was no artificial intelligence, but I knew it would be essential to ensure the sustainability of our business and its potential for development beyond our borders. So just after launching, we started working on the creation of our algorithm.

Pioneer, I don't think so. Many companies pride themselves on using AI. When we talk about Artificial Intelligence, we imagine very complex and very powerful technologies. A universe beyond us, close to science fiction films. In reality, in most cases, like ours, it's bits and pieces that we've been automating as we go along, on targeted elements.

### **How does your AI work?**

Then, a recommendation algorithm to push relevant or unmissable content to our users according to their tastes, their location, the weather, etc. which we had to abandon because its operation was compromised by the rise in power of the GDPR. This made people less inclined to create accounts, sharing data simple and risk-free. The excesses and scandals of the GAFA harm us on a daily basis because people put all companies and services in the same basket. Even those who don't do anything with their data other than use it to provide them with more relevant content.

### **Would your business be possible without the support of AI?**

Possible yes... but not in Luxembourg. It would require a lot more hands and would thus make the financial balance of our business almost impossible. Not to mention the fact that having managed them myself for more than a year in the beginning, these tasks and missions have no "cerebral" interest. They are repetitive, with low added value, and totally uninteresting in terms of intellectual stimulation. So, I'm glad they're coming back to Vorax, our 100% content-hungry algorithm, which empowers humans to do thinking, strategy, and creative tasks.



04

**04. 05. 06. 07.** Tools using artificial intelligence are more and more widespread in the professional world and are used in various contexts such as sales assistance thanks to augmented reality (04), new means of payment (05), customer service and call centres (06) or even chatbots for online sales or the animation of websites (07).

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campaigns and facilitates contact between interested parties.

In **healthcare**, AI is penetrating many segments of the medical industry. It is said to be more effective than a doctor in detecting the cancerous nature of a melanoma, or in analysing MRIs. Fuelled by a huge mass of data, AI has the potential to improve medical processes and care (saving time and improving quality). Indeed, exponential computing power enables an increasingly sophisticated search for correlations, allowing doctors to better detect and interpret symptoms and predict the progression of diseases. Researchers, meanwhile, are gaining the ability to anticipate the side effects of drugs at the clinical trial stage. Health technologies (or HealthTech) are one of the avenues for economic diversification in Luxembourg. In this field, the QTrobot from the LuxAI company, which helps in the treatment of children suffering from autism spectrum disorders, is an example of an innovative, internationally successful Luxembourgish initiative.

### **All concerned**

In the **field of commerce**, the collection and analysis of data on the previous behaviour of individual consumers makes it possible to predict their needs and offer them tailor-made products. The use of recommendation engines, advertising content optimisation programs and conversational robots (chatbots) can increase the conversion rate of merchant websites and reduce the



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use of customer service call-centres, which translates into increased revenue and reduced costs, hence better margins. In Luxembourg, the collection and use of purchase history and consumer habits are relatively well anchored in the habits of large retail chains. Smaller companies are less likely to use these technologies. To encourage them to seize the opportunities offered by digital tools and find the right contacts as well as financial subsidies, the Chamber of Commerce and its House of Entrepreneurship offer the free program Fit4Digital.

In another area, recent years have seen a boom in **voice recognition**. In the domestic context, Amazon Echo or Google Home devices, for example, constitute digital home helpers, performing tasks as diverse as home automation management, shopping or meal orders, taxi reservations or even broadcasting information or music. The intelligent applications Siri from Apple or Bixbi from Samsung understand verbal instructions given by users and respond to their requests. In Luxembourg, there are also the Made in Luxembourg virtual assistants. Thus, Supermiro is a site and an application that makes suggestions for entertainment and Helloboss is its equivalent for professional activities.

In the **hotel, restaurant and café (Horeca) sector**, the use of AI can have many benefits. Restrictions linked to the Covid-19 pandemic caused a rapid development of home meal ordering and delivery services. Applications to identify places where

cases of contamination have occurred also appeared. The use of AI also lends itself very well to repetitive tasks such as booking and order taking, and this can help reduce management costs and human errors. Services have also been improved thanks to the possibility of allowing customers to easily personalise their orders whilst receiving product suggestions based on their purchase history. The time thus freed up can be used to improve customer relations. Finally, AI applications are key marketing tools by facilitating customer profiling and contact through advertising personalisation. In Luxembourg, the sectoral study of trends in trades and skills, conducted in November 2021 by ADEM and Horesca, noted that the sector has remained rather traditional and integrated innovative technologies less quickly than in other countries. Presence on social networks is nevertheless a relatively well-developed practice.

In the **environmental field**, AI can be of significant help in combating climate change and ensuring a transition to more sustainable production methods. Applications abound at this level, ranging from regulating the energy consumption of smart buildings, to establishing short circuits and protecting biodiversity. In France, for example, the mathematician and deputy Cédric Villani, proposes the creation of a database that would cross-reference data related to electricity consumption in France, the level of air pollution, rainfall and sunshine. Analysing these figures would make it possible to adjust energy needs and production in

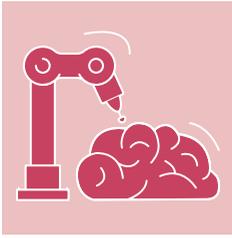
real time while minimising pollutant emissions and better directing the use of pesticides in agriculture. Luxembourg, for its part, is in the process of building an intelligent electricity network (smart grid), allowing energy production and consumption to be monitored in real time and optimised.

**AI-powered growth**

Since AI has applications in many fields and sectors of the economy, it is not surprising that the majority of economic studies predict that it will have a significant impact on the global economy. Thus, a PwC study estimates that the deployment of AI could contribute 14% of global growth (i.e., 15.7 trillion dollars) by 2030. China and North America are likely to see the biggest gains.

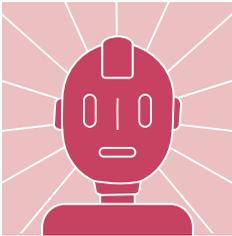
AI has the ability to drive growth in many ways. Firstly, it will allow the economy to make significant gains in productivity. A study conducted in 2020 by Accenture

*“In the 21<sup>st</sup> century, data is omnipresent and forms one of the major vectors of economic growth.”*



## The other artificial intelligence

Researchers have succeeded in cultivating brain cells from embryonic mouse brain cells and human stem cells, "connected" to a network of electrodes. They thus obtained a "mini-brain", called DishBrain, which they taught to perform specific tasks. "It is able to take information from an external source, process it and respond to it in real time," says Dr. Brett Kagan, who is leading the experiment. The device was evaluated with the game Pong, electrical impulses indicating the position of the "ball" in the game. DishBrain showed signs of learning after 5 minutes of play and, after 20 minutes, started to play better. The scientists concluded that the cells had reorganised themselves, had developed networks and had indeed learned.



## AI in fiction

Artificial intelligence has long inspired authors of (science) fiction, whether in literature or audio-visual works. A small non-exhaustive selection to occupy the winter evenings...

Novels:

- "I, Robot" by Isaac Asimov (1950)
- "Golem XIV" by Stanislaw Lem (1981)
- "Neuromancer" by William Gibson (1984)
- Neal Stephenson's "Diamond Age"
- "Murders, in all intelligence" by Jacques Attali (2018)
- "M, the edge of the abyss" by Bernard Minier (2019)

Movies and series:

- "Blade Runner" by Ridley Scott (1982)
- "Matrix" by Lilly and Lana Wachowski (1999)
- "A.I. Artificial Intelligence" by Steven Spielberg (2001)
- "Her" by Spike Jonze (2013)
- "Ex Machina" by Alex Garland (2015)
- The "neXt" series by Manny Coto (2020)

**08. 09. 10.** The industrial and logistics sectors also use techniques using AI to automate manufacturing, customise certain products, perform predictive maintenance or manage warehouses of parts or goods.



reveals that in the next 10 years, AI will save up to 90% of the time spent performing certain tasks, thanks to automation and/or the support of technology. Automating routine tasks will have three impacts. First, it will reduce labour input requirements and have a strong impact on human capital-intensive sectors such as industry and transport. Second, it will free up time for the workforce to focus on more interesting and higher value-added tasks. Finally, the workforce will be more effective and efficient thanks to the assistance of smart technologies but will also be more motivated by having more interesting tasks to carry out. According to a 2021 survey by telecommunications specialist Juniper Networks 74% of North American, European and Asian companies saw an increase in employee satisfaction following the introduction of AI tools to assist them with operational tasks and 82% say AI has freed up time for employees to focus on higher value tasks.

AI will also drive growth through the emergence of a "virtual workforce", i.e., intelligent automation based on "machine learning", where software will be able to solve problems and evolve by acquiring experience itself via the data collected.

As AI is a major technological innovation, it will drive the creation of new goods, services and industries that will generate new revenue streams to fuel growth.

Finally, AI is likely to create a virtuous circle of growth in which supply and demand would feed each other respectively. Thanks to the collection and analysis of data, some of its applications make it possible to personalise goods and services according to customer profiles, as closely as possible to their expectations, but also to anticipate the potential needs that will shape future demand. By stimulating demand, the AI collects more and more data concerning the latter, which allows the supply to respond even better to market expectations, hence an even more stimulated demand, etc.

## What can be the benefits of AI for companies?

The use of AI-related applications has many advantages for companies. One of them is that it allows the rapid collection, analysis and modelling of an amount of data that would be too large to be managed by the human brain alone. Without technological support, the decision-making process is generally based mainly on intuition,



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experience and the consideration of limited data and parameters, which leads to well-considered choices, but which leave a lot of room for unknowns. A study conducted by McKinsey in 2018 notably demonstrated that in 2/3 of cases, the use of AI would bring the company a performance improvement greater than that which can be achieved via other analytical tools.

Thanks to AI, companies can develop areas of activity complementary to their core business and secure customers and income over the long term. In manufacturing industries, for example, the use of predictive maintenance makes it possible both to anticipate breakdowns in the factory (and thus avoid setbacks and additional costs linked to production stoppages) and to improve the offer and customer satisfaction by offering services to increase product lifespans. By building such an “after-sales service”, companies create customer loyalty, facilitate inventory management and acquire new revenue channels by moving up the value chain.

Constantly optimising its production model is essential for any company that wants to remain productive, profitable and competitive. Currently, process improvements most often result from focusing on the areas



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11. In the health field, AI is very useful for interpreting medical imaging or analysing results. Its computing power enables it to compare data from many patients very quickly to refine and accelerate diagnoses.

of action considered the most profitable, where the gain from the change is greater than the costs incurred but they are rarely based on the entire production model, and never by including impactful external information such as the economic situation, weather conditions or news relayed by the media. Thanks to AI, companies will be able to integrate all these variables into a single model to optimise their way of producing and thus reduce their costs. According to McKinsey, the adoption of AI by companies had already concretely enabled them to increase their revenues by 10 to 20% in 2020. AI will eventually be present in all parts of the economy. Companies that act early to integrate this technological change into their development strategy will benefit from a competitiveness bonus compared to their competitors.

### AI can help all business functions...

According to the results of the survey carried out by McKinsey in 2021, the business functions for which the adoption of AI (use of at least one application using AI) is the most widespread are customer services (customer relations, back offices, field services, call centre automation, etc.), the development of new products and services (optimisation of product characteristics, etc.) and the marketing/sales function (analysis of data customers, customer segmentation, etc.). In addition, other departments of the company may have an interest in using AI applications, for example financial services for cash management; the purchasing and supply function for sales forecasting and optimisation of the logistics network; production for the implementation of predictive maintenance of machines or the optimisation of energy consumption; the human resources department for career and talent management; the legal department for the review or production of contracts or the verification of regulatory compliance; or even the IT department for the implementation of assistance chatbots or the preventive detection of incidents...

### ... but represents an organisational challenge

AI is a radical technological innovation. To take full advantage of its benefits, companies will have to make organisational changes to integrate it as well as possible into their processes. Currently, the various departments of a firm mostly work in “silos”, with their own data and repositories, and collaborate with other teams on an ad hoc basis. AI will decompartmentalise the organisation by grouping and processing the totality of the company’s data. From there, it will be possible to identify unsuspected correlations, to reproduce them by creating collaborative bridges between the departments, and to unify the repositories (ex: references for purchases and accounting) which could once be specific to each team. Decpartmentalisation will require transformation and therefore the need for the company to train employees to work on common data and repositories that they will have to learn to share and unify.

Moreover, since AI allows routine tasks to be performed, companies will be able to reduce the need for external service providers providing low value-added services and thus reduce their costs. In the finance function, for example, this would mean entrusting the video coding of invoices to an internal employee equipped with a new AI tool. This “reinternalisation” of processes would also allow companies to control the quality and increasingly strict regulatory compliance of the tasks carried out.

With the introduction of AI in business, some low-skilled positions will disappear, but new functions will emerge, and staff will have to be recruited or trained to introduce new AI applications, maintain them, improve them and use them. New professions are already appearing in organisational charts. The data analyst uses the mass of data collected and determines the most relevant to boost the growth of the company. The chief data officer is responsible for managing and processing data and



### Gregory Nain

Co-founder, Head of Operations,  
DataThings

**“People mistakenly think that an AI project is necessarily large-scale”**

#### What does your business consist of?

We specialise in developing what are known as Digital Twins to help drive operations for many types of businesses. This results in the development of software capable of classifying, predicting, or simulating operational situations by exploiting learning algorithms. The applications are vast, such as the management of a national electricity network, logistics and production, energy saving, or risk or fraud management. In order to respond quickly and precisely to operational needs, we own and develop a unique data processing technology: GreyCat. If necessary, we also support companies in the selection and aggregation of relevant data for the implementation of real-time analyses and the creation of prediction tools.

#### How is the demand for your services changing?

Sometimes only 2% of the data generated by production tools is "monitored" meaning that essential indicators will probably be overlooked, simply for lack of suitable analytical tools. Analysing the causes of production faults is sometimes hampered by an excessive quantity of data, the need to realign measurements over time, or the over complexity of interactions which a human brain is unable to comprehend them. This is where machine learning tools can be deployed to perform these analyses. In short, in any company there is data that is not exploited because of its complexity, its volume, or a lack of time, and so companies are beginning to identify analysis and learning technologies to facilitate its exploitation.

#### Do SMEs also call on you?

Yes, but they are not very numerous. However, they are often those who can make significant savings from the first learning or even simple analytical processing. Typically, adapting a process to energy costs is more crucial than ever. We mistakenly think that an AI project is necessarily large when it is always repetitive. We recommend starting with a small project and we support scaling up if successful, when large amounts of data are needed, and our know-how and technologies provide solutions.



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**12.** Social robots like the QT Robot from the Luxembourg start-up LuxAI (pictured) are autonomous. They interact and communicate by following the social behaviours of humans. They can be used in the treatment of certain disorders or to facilitate the daily life of the elderly or disabled.

© 12: LuxAI

**13. 14. 15.** In the domestic sphere, for several years we have seen the success of voice assistants (13) and many other applications allowing you to manage your life on your smartphone, from monitoring your expenses (14) to adjusting your home automation equipment (15).

© 15: Dovit

guaranteeing its quality. The data architect sets up the infrastructure for collecting raw data and the data scientist understands and models the various business issues of a company and develops predictive models to anticipate changes in the data and the company's business sector.

#### Are AI technologies accessible to SMEs?

Like their larger counterparts, SMEs can benefit from new revenue streams, cost reductions and process optimisation through AI technologies. Their implementation is simpler in a context of where data is less abundant and from known sources and, so, companies of modest size may be able to introduce modern solutions which will enable them to concentrate on their core business while reducing the fixed costs associated with day-to-day business management.

The adoption of AI Software as a Service (SaaS), i.e., solutions hosted in the Cloud, is particularly suitable for SMEs because they are relatively simple to install and configure, while having a positive return on investment (ROI) regardless of the size of the company. An SME operating in B-to-C could, for example, use SaaS and pay a subscription to add a "chatbot" to its website rather than having it developed in-house. Another possible use is the management of data optimised by artificial intelligence to enable SMEs to get to know their customers better, to personalise interactions with them and to



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offer them relevant product recommendations through "upselling" (selling a product or service with higher added value, editor's note) or "cross-selling" (offering customers one or more additional products and services, editor's note). Artificial intelligence could also be used to communicate better, in a more targeted and therefore cheaper way, to automate the sending of personalised communications and to analyse the results of marketing campaigns.

For SMEs with uncommon business models, the development of tailor-made AI software corresponding to a specific core business remains relatively expensive. Thus, for this type of project, it may be useful to contact experts to assess their profitability beforehand.

Despite all the opportunities that the introduction of AI tools in business models may represent, the fact remains that adopting innovative technologies always requires the investment of time, money and skills, which may not be easy for modestly sized companies.

### What are the barriers to adopting AI?

A study conducted in 2021 by Juniper Networks identified three frequent obstacles at the global level. First of all, a technological barrier corresponding to the difficulty of setting up an infrastructure to support AI solutions and the difficulty of collecting the copious amounts of labelled data that can

be used by new tools. Then comes a human barrier: 2/3 of the companies surveyed said they had difficulty training their staff to integrate new AI systems. The third obstacle is organisational and relates to the difficulty of finding managers who can define and supervise the AI strategy and create dedicated teams well positioned within the company's general organisation.

In Luxembourg, a 2021 study by PwC Luxembourg revealed the three reasons most often cited by local companies, from all sectors, as preventing them from implementing AI tools. These were the lack of qualified personnel (cited by 58% of companies), lack of knowledge about the technology (48%), and lack of visibility regarding the return on investment of AI projects (30%). Additionally, employee resistance to implementing AI tools appeared to be a major challenge for almost a third of large companies. Finally, a lack of financial resources was cited as a problem by 36% of firms in the financial sector.

The use of AI in business is a relatively new thing. The related regulations are still being defined. This can generate uncertainty for firms. To help companies see things clearly, the Chamber of Commerce keeps a permanent legal watch.

### And what are the risks associated with its use?

McKinsey's study "The State of AI in 2021" showed that the risks most often identified

by companies, worldwide, regarding the use of AI were related to cybersecurity (data security in the context of computer attacks), regulatory compliance and the ability to explain an AI's reasoning in reaching conclusions.

Aware of the importance of data security in a digital economy, Luxembourg has implemented a dedicated national strategy, along with the portal [www.cybersecurity.lu](http://www.cybersecurity.lu).

If the techniques of "machine learning" have allowed considerable progress in AI, there remains for the moment a major drawback: the opacity of the operation. If the data that we use to feed the AI as well as the answers it provides are clearly visible, there is still a grey area concerning the way in which the data is processed by the machine to achieve its results: we can then speak of the phenomenon of the "black box". In machine learning, a multitude of examples will be presented to the AI which will update its coefficients by comparing the expected result and the result obtained. In this case, there is no visibility on the internal working of the machine, which can prove problematic if one wishes to use AI applications in cases where errors of judgment could have profound consequences like locating tumours with X-rays or when driverless cars try to detect pedestrians.

In business, for whatever purpose, the decisions that come out of an algorithm must be understood by the professionals who use

***“In manufacturing industries, the use of predictive maintenance makes it possible to anticipate and avoid breakdowns in factories.”***

them. Without being able to understand the basis of decisions, they will not be able to validate them and take responsibility. In the end, they will not adhere to these tools which, moreover, will not comply with the law. Businesses can mitigate the risks of using AI, for example, by documenting the patterns created in a way that makes the operation of AI tools transparent and legally compliant.

To function, an AI system feeds on data. In accordance with the saying "trash in, trash out", the quality of the models generated by the tool depends on the quality of the information absorbed, which must be representative, statistically significant and unbiased. Before using AI, a company must therefore clean up its databases and put processes in place to ensure that any new data generated is "clean" if it is to be used effectively by the new tools. It is recommended to use data, legal and risk experts to systematically assess the data before entering it into the AI system. An additional precaution would also be to put in place processes for testing, verifying and regularly updating the models generated by the AI to ensure that they are still relevant.

### **Where is Luxembourg in the adoption of AI?**

LPwC's "Use of Data Analytics and Artificial Intelligence" study compared the results of two surveys conducted in 2019 and 2021 among a representative panel of Luxembourg companies and made it possible to observe the country's progress as an economy based on data.

Local companies are increasingly aware of the power conferred by the collection and analysis of data. They have tried in recent years to put data at the heart of their decision-making processes. Thus, in 2021, around 30% of companies were ready to invest at least 3% of their turnover to deploy AI tools. These have been increasingly



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adopted in Luxembourg since in 2021 with more than half of the companies questioned use AI against only a quarter in 2019. In addition, the proportion of firms which either already use this technology, or are planning to do so, or thinking about it, reached 82.5% in 2021, i.e., more than three quarters of the companies surveyed.

More companies are also creating dedicated departments to deploy and manage AI systems (57.1% of respondents in 2021 compared to 29% in 2019) which previously were the responsibility of other departments such as R&D, information systems or general management.

The PwC study nevertheless underlines that while Luxembourg is beginning to realise the value of data, it is still relatively far from being "data-driven", as companies do not yet systematically rely on data analysis to make decisions and guide their development.

Asked about their degree of maturity in relation to the various AI applications used, the majority of companies (90%) declared, in fact, in 2019 as in 2021, they were focussed on the subject of data confidentiality. Data analytics and architecture – the practice of standardising the collection, storage, processing and distribution of data – has however progressed well between 2019 and 2021, with 52.5% and 45% of companies say they are mature in these areas compared to 29% and 27% two years earlier. On the other hand, the integration of data in

the decision-making process is stagnating since it remains around 42% in 2021 as in 2019.

AI technologies were first used by Luxembourg companies for "defensive" purposes in the context of "compliance" procedures, regulation and the fight against fraud and cyberattacks. The results of the survey conducted in 2021 by PwC show an evolution towards more "offensive" uses in order to conquer new market share or gain in competitiveness. Indeed, local firms are increasingly using AI to analyse predict, better know, evaluate and serve their customers and/or support their decision-making processes.

In general, operational companies (i.e., those that produce and sell goods) invest mainly in applications for analysis, prediction, decision support, cybersecurity and internal control.

### **New diversification prospects for Luxembourg...**

The combination of finance with Big Data technologies has given rise to FinTech, which optimises financial services (loan agreement, savings management, online payment, etc.). According to the PwC study, the financial sector, which represents more than a quarter of Luxembourg's GDP, shows the most interest in the use of AI, in particular to facilitate the knowledge and rating of clients. The sector is particularly advanced



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in the development of prediction algorithms to improve financial performance. With a view to making Luxembourg a leader in the field of digital financial services, the government has made the digital transformation of this sector a strategic priority.

Among the other avenues of economic diversification targeted by Luxembourg, there is also the HealthTech sector, whose role has become recognised as all the more important since the COVID-19 pandemic. In Luxembourg, according to the latest estimates of the dedicated cluster, there are 136 private companies involved in HealthTech. Of these, 30% are active exclusively in the digital realm and some are in AI.

Luxembourg certainly intends to play this card in the future to accelerate its economic diversification. Something to keep an eye on. ....

**16. 17.** In the field of transport and mobility, the driverless car is becoming a reality, as evidenced by the electric shuttle operated by the Luxembourg company Sales Lentz (16) or the tests carried out on a cross-border circuit by a group of researchers at Greater-Regional level (17).

© 16: Sales Lentz  
17: Marie de Decker

**More information:**

Consult the publication *Actualité & Tendances* N°27 on: [www.cc.lu/toute-linformation/publications](http://www.cc.lu/toute-linformation/publications)



**Kelly Xintara**  
Legal Advisor, Chamber of Commerce

*“The very definition of AI is at the heart of the debates”*

**Why is it important to regulate the use of Artificial Intelligence (“AI”) ?**

The question deserves to be asked because other major players in the global market, such as the United States or China, have not adopted a legal framework. Regulating AI is, according to the European Commission, building trust. Furthermore, legal certainty promotes innovation in the field of AI in Europe. However, the difficulties with such regulation are numerous: the complexity, opacity and autonomy of AI systems sometimes make it difficult to understand how they work... machine learning AI is not a consumer product like any other. In addition, we are trying to regulate a technology with which we are not yet really in contact: will our future uses make us reconsider this European legal framework?

**What are the main aspects covered by the AI proposal under discussion at European level?**

They are numerous. I will therefore focus on some issues affecting businesses: the very definition of AI is at the heart of the debates because it must be both precise and broad enough to encompass future technological developments. It must therefore make it possible to distinguish AI from “traditional” software. Another issue is determining the type of AI systems that should be classified as “high risk”. An important question for companies, because this classification implies several obligations before and after placing such systems on the market. The intensity of human participation in algorithmic decision-making also needs to be further explored by European legislators. Finally, I would mention the discussions around the operation of “regulatory sandboxes” - controlled environments in which private actors can experiment and test, for a limited time, new AI products.

**What will be the next “Ready for AI” events offered by the Chamber of Commerce?**

The next part will be devoted to the clear and concrete presentation of the obligations of companies that want to develop or use artificial intelligence systems. However, we should wait for the adoption of the final regulation on artificial intelligence, scheduled for 2023. We are aware that some companies, in particular SMEs and start-ups, do not have the possibility of consulting specialists, and thus have difficulty understand the issues, particularly in terms of compliance. Our goal is to guide them as best as possible in this complex exercise.