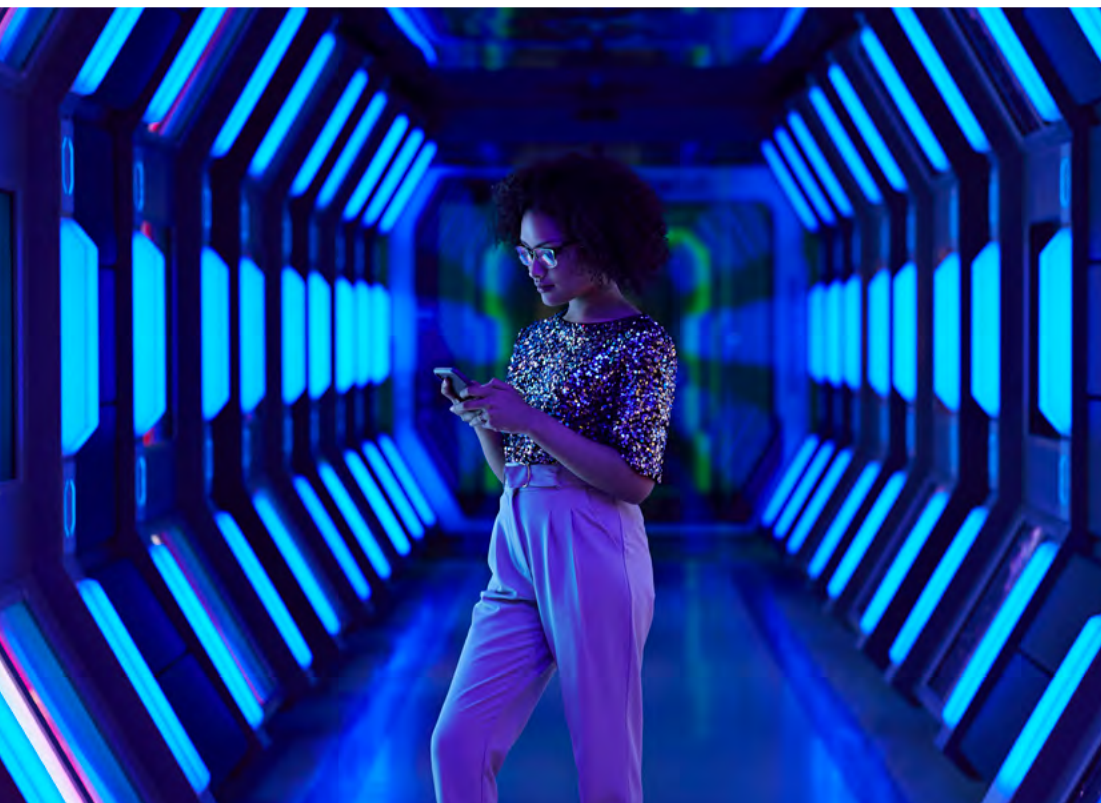


Use of Data Analytics and Artificial Intelligence 2021

What has changed for Luxembourg companies in the past two years?

September 2021



```
mirror_mod.use_x = False  
mirror_mod.use_y = False  
mirror_mod.use_z = True
```

```
#selection at the end -add
```

```
mirror_ob.select= 1
```

```
modifier_ob.select=1
```

```
bpy.context.scene.objects.active
```

```
print("Selected" + str(modifier_ob))
```

```
mirror_ob.select = 0
```

```
one = bpy.context.selected_objects
```

```
one.data.objects[one.name].select
```

```
print("please select exactly one")
```

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Executive summary



Introduction

In 2021, Artificial Intelligence (AI) is no longer a new phenomenon knocking on doors with opportunities. AI is already integrated very well into our daily lives, especially in the way we do our business. Over the last few years, companies in most industries have recognised the importance and urgency to get onboard with the AI revolution and have invested time and money as well as the best of their talent into AI related projects.

PwC Luxembourg has conducted a study to better understand where Luxembourg companies stand in terms of Data Analytics and Artificial Intelligence. This study is a sequel to our first “Use of Data Analytics and Artificial Intelligence by Luxembourg companies” study, conducted in 2019. It is therefore aimed at tracking the progress of the Luxembourg ecosystem. The landscape has developed rapidly in just two short years that were disrupted by the pandemic. Data & AI are on the radar of most companies in Luxembourg and they have hired experts in this field and implemented projects accordingly.

This study also aimed to understand what types of strategy Luxembourg companies currently have in place to manage data, the types of technology they use, and how they are investing towards adopting a data-driven culture. The detailed results are presented in the following pages.



Thierry Kremser

Data & AI Leader
PwC Luxembourg

“The COVID-19 pandemic has been a disruptive force in Luxembourg and the world for the past 18 months. In our second edition of this survey, we asked Luxembourg’s data leaders on their own experience and developments since 2019. In this report you will see that Luxembourg’s companies have responded to the challenge with an increased and more impactful use of Data Analytics and Artificial Intelligence in their business.”

How Data-Driven is Luxembourg?

A data-driven strategy and approach allows a company to inform themselves and exploit the most crucial insights that are often not obvious, even to the most immersed professionals.

In Luxembourg, companies are generally becoming more data-informed i.e. there is a higher consciousness over the power of data collection and analysis and efforts have increased in having data being a key ingredient in business decisions. However, being data-informed can be very different from being data-driven.

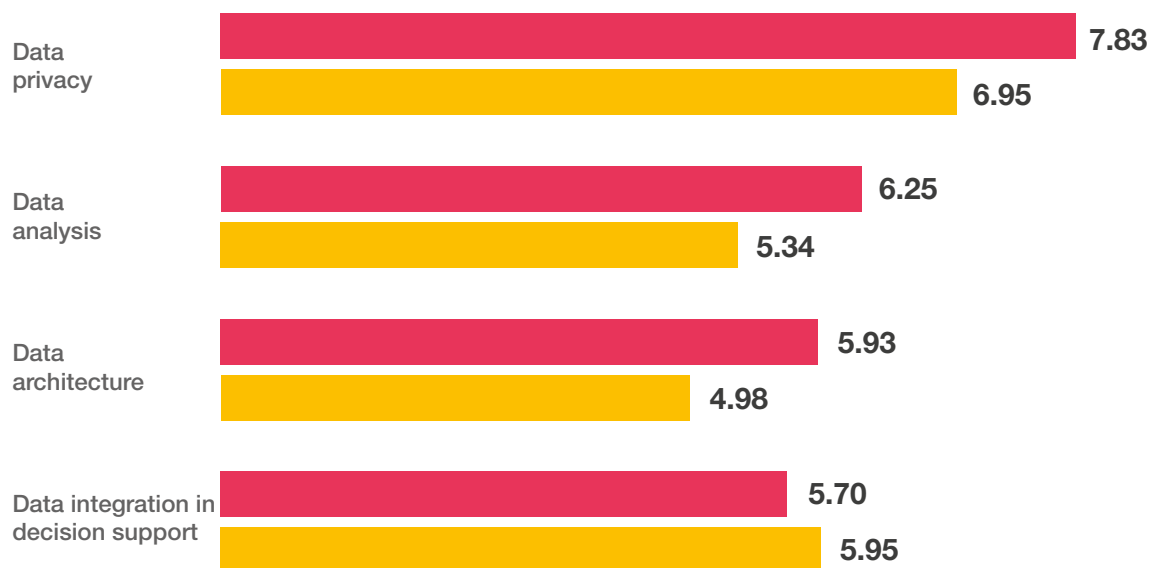
Companies in Luxembourg have been quite slow in consolidating a firm level data strategy and have rather depended on teams and projects to manage their data as per their own convenience. In 2019, only **29%** of the companies had a clear and defined strategy for managing data in the company. This number has risen only up to **35%** in 2021 demonstrating a perceived lack of effort and utility.

According to our study, **data privacy** continues to be the area of highest focus with about 90% of companies already attaining maturity. This is not surprising as the GDPR regulation came into force in May 2018 and has been a major contributor in driving companies towards stricter data protection policies, while the CNPD started making its first fines public in 2021. Moreover, adopting a more data-driven approach, half of Luxembourg companies have high maturity in domains such as **data analysis** and **data architecture**. Also, 42% of companies show high maturity in **data integration in decision support** which is a key indicator of being a data-driven company.

On a scale of 1 to 10, how would you rate your company in terms of maturity with regards to...

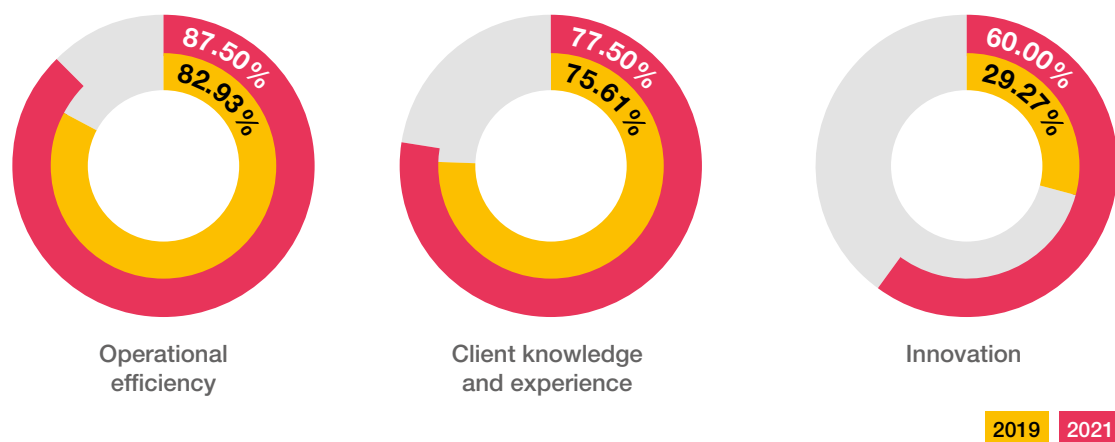
Data privacy	Data analysis	Data architecture	Data integration in decision support
90% of respondents consider their company to be mature (indicated by selection between 7 to 10)	52.5% of respondents consider their company to be mature (indicated by selection between 7 to 10)	45% of respondents consider their company to be mature (indicated by selection between 7 to 10)	42.5% of respondents consider their company to be mature (indicated by selection between 7 to 10)
70% in 2019	29% in 2019	27% in 2019	41.5% in 2019

On a scale of 1 to 10, how would you rate your company in terms of maturity ? (Average)



If we look at the average score, results indicate that all domains have matured except for data integration in decision support.

Main reasons for collecting data (full results available p. 18)



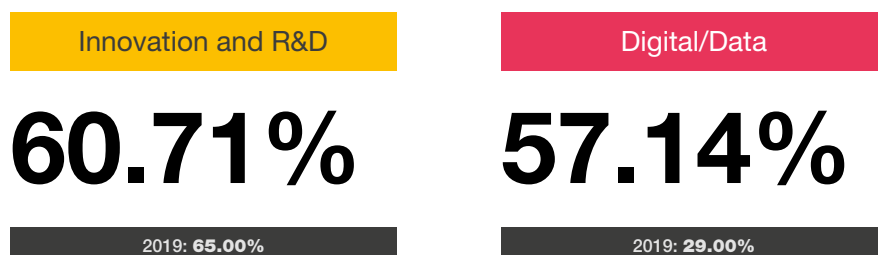
The top reasons for data collection in 2021 remain **operational efficiency** and **client knowledge and experience** just as in 2019. The data collection for the purpose of leading **innovations** has more than doubled in 2021. This insight is a key indication of Luxembourg companies embracing a more data-driven culture, and trying to gain a competitive advantage over their peers

Embracing and Investing in AI

There has been a widespread increase of acceptance of Artificial Intelligence in Luxembourg companies over the past two years with only **24%** of companies utilising AI tools and services in 2019 to over **52%** in 2021 with another **20%** piloting soon.

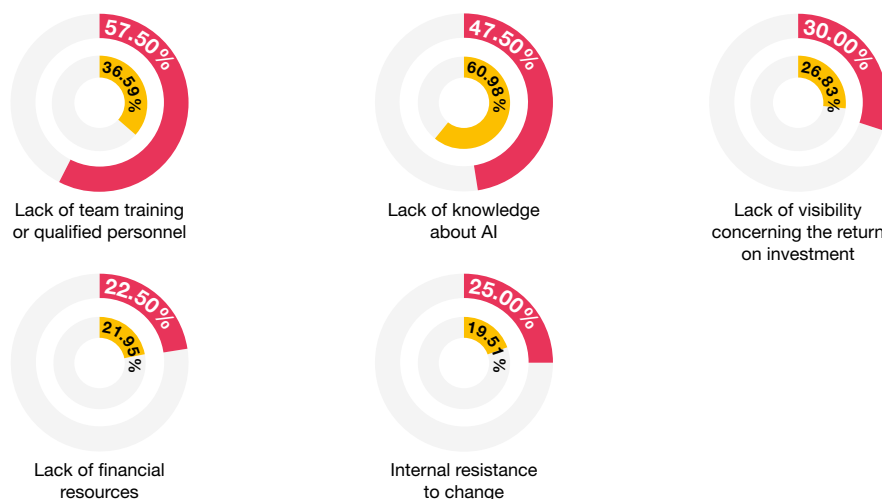
Evidently, AI has become a subject for business and **digital/data teams** rather than just **R&D and IT teams** as it was a few years ago. Thanks to advancements in AI services, training and business use cases, data professionals can now lead AI projects. This is in line with key trends globally that see an increased **operationalisation of AI**.

Main divisions responsible for piloting AI-related projects (full results available p.28)



However, the biggest hurdle in the deployment of AI remains the lack of training, experts and general knowledge of AI among company executives, as experienced by **over 50%** of the companies. This hurdle has become even more significant since 2019, which is visible on the employment market, where the demand for data talent remains very high.

Main reasons for not deploying AI in Luxembourg (full results available p.33)



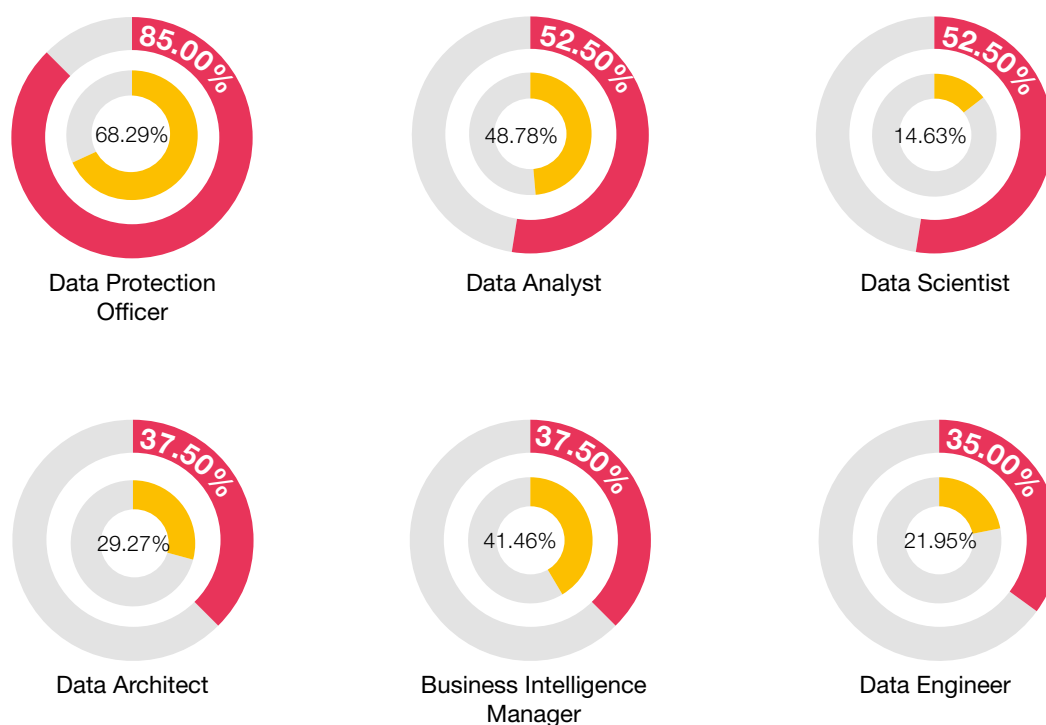
Invest in people

The war for talent is not over yet, as 50% of companies rely mostly on internal tools and resources rather than on external ones (20%).

This is complemented by the companies actively recruiting and developing data science teams.

There has been a significant jump in the number of companies employing Data Scientists from **14% to over 52%**, while Data Architects and Data Engineers are now present in more than a third of Luxembourg companies. This clearly indicates the rise in demand for AI initiatives as well as the talent that can execute it.

Data-related positions in place within Luxembourg companies (full results available p.16)



Conclusion

AI has matured in Luxembourg since 2019. While our study is not able to conclusively tell if the COVID pandemic is a detractor or driving this trend, the numbers indicate a move towards the operational use of AI.

Luxembourg is data driven and getting more so!

Luxembourg companies are incorporating advanced analytics tools and data expertise into their day-to-day business, to increase knowledge on customers, foster innovation, and optimise their processes. Luxembourg is well positioned on a global level, when it comes to the adoption of AI tools and moving from spreadsheets to tailored data solutions. The use of AI tools has already doubled since 2019 and is bound to grow further in the future. Indeed, according to the Government AI Readiness Index 2020 (Oxford Insights), Luxembourg is ranked in the 15th position (out of 172 countries) and in the 9th position if we look at Western European countries only. Besides, the Responsible AI Sub-Index indicates that Luxembourg is highly competitive, achieving a third rank.

Functional specialisation is indicating a higher data understanding and maturity

Increased specialisation in the data domain is also becoming apparent, with growing roles in data architecture, data management, and data governance. Instead of single data scientists, more commonly whole teams are present. However, talent remains a main concern, with most companies reporting on difficulties in finding the most quality candidates in a scarce talent pool.

High acceptance of Cloud Computing for data tasks

The cloud is also finally arriving in Luxembourg's companies. Almost three of four companies are already using cloud computing in their data processing, or plan to do so in the near future. In particular small and medium enterprises are embracing the lower investment and opt against setting up their own data infrastructure.

Policies are driving steady change even at the lowest levels

The adoption of AI & data tools in the key sectors of Luxembourg's industry is quite different. While spreadsheets still reign supreme in the financial sector, there is a strong trend towards specialised data and business intelligence tools. The Public Sector has seen the strongest transformation. Driven by the European Strategy for Artificial Intelligence, and Luxembourg National AI strategy shortly after, public entities have increased their investment significantly and are embracing AI at unprecedented speed.



Impulse to research and confident to invest in AI

Luxembourg has attracted the 4th highest investment per capita in AI as reported by the Financial Times in 2019. These investments have already started to show their effects as we can see through the findings of the survey. Companies in Luxembourg find it easy to create PoCs to test new concepts and possibilities in Data and AI and at the same time are dedicating significant share from their turnover into the development of AI. Although there are new challenges such as lack of talent and visibility on return of this investment, AI initiatives have found to be well resourced in Luxembourg.

The next challenge is to acquire talent and develop responsible approaches towards AI

There remains room for growth for AI in Luxembourg. Still, a large number of companies do not fully leverage the new technologies and risk falling behind the competition, citing the lack of talented people and lack of clarity about the return on investment as main reasons for this. On the horizon, there are also additional factors, such as the planned European Regulation on high-risk AI systems, that may in particular significantly impact the financial sector. A responsible approach towards the use of AI and strong regulatory support can help Luxembourg to have a bright future with AI helping to fuel the economy.

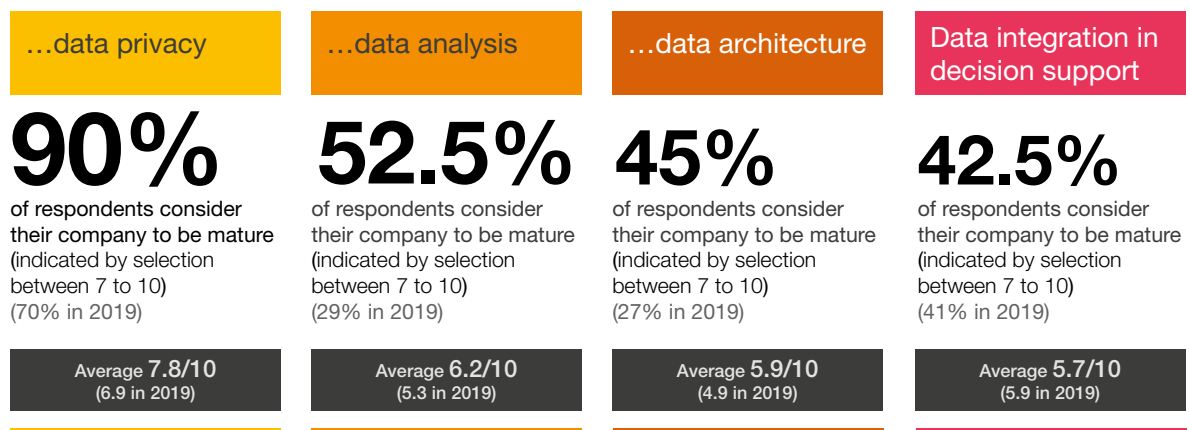
Survey

results

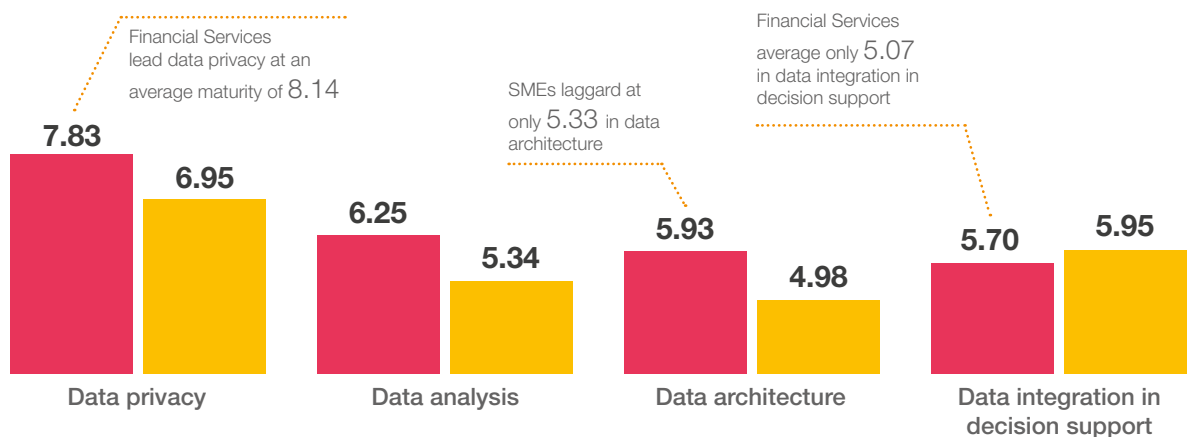


Data Governance and Strategy

On a scale of 1 to 10, how would you rate your company in terms of maturity with regards to...

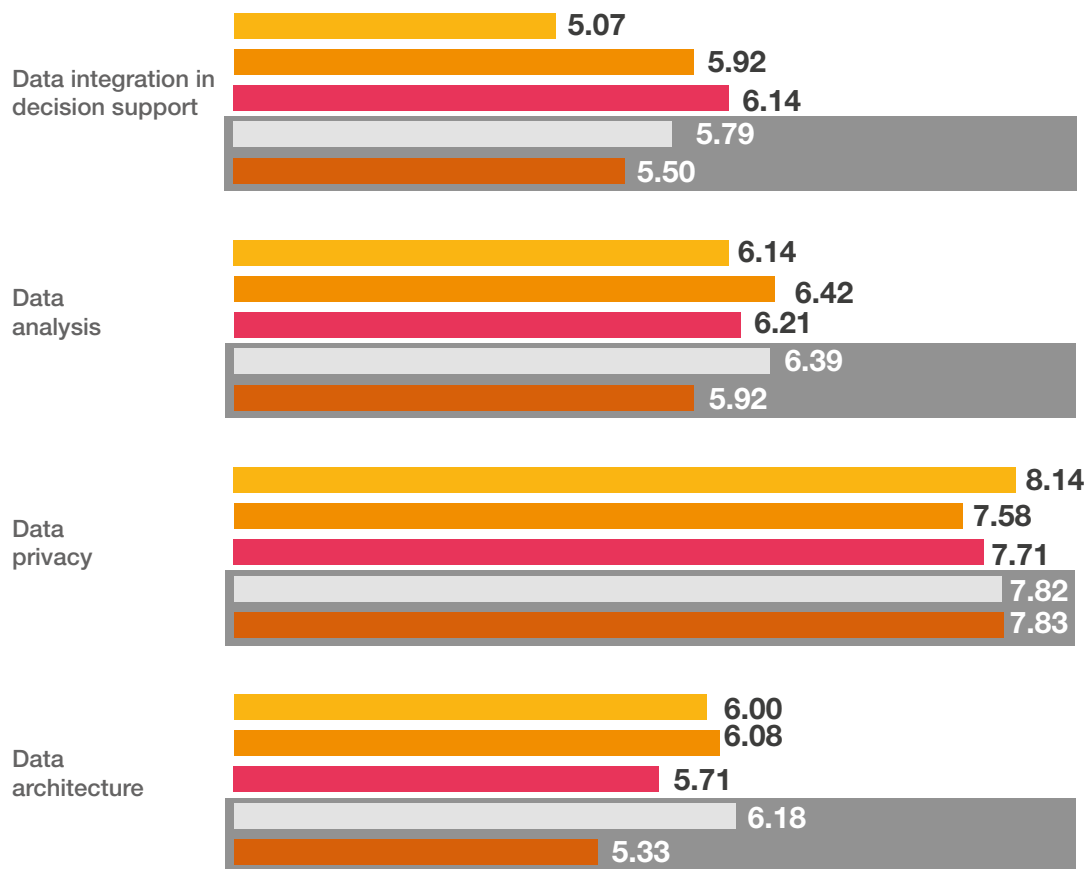


On a scale of 1 to 10, how would you rate your company in terms of maturity? (Average)

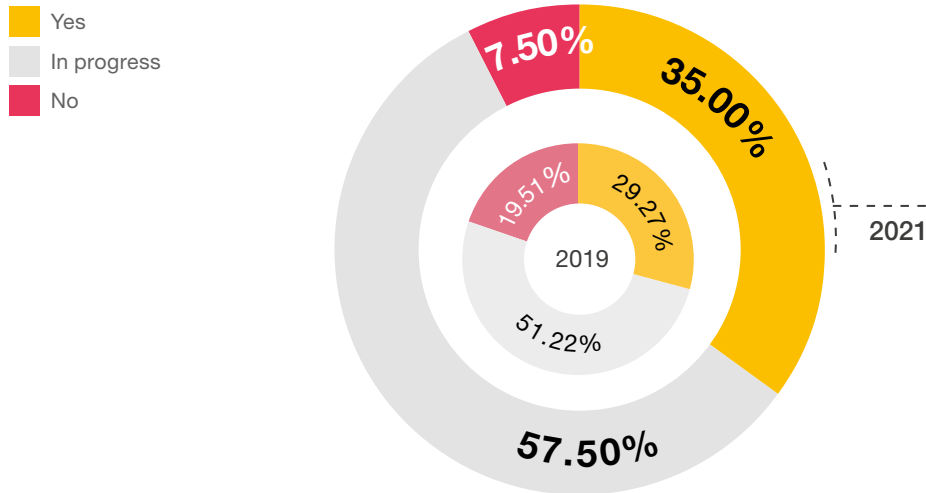


Luxembourg companies consider themselves well equipped to comply with Data Protection rules and regulations as data privacy continues to be the field in which the companies claim the highest maturity. There have been tremendous improvements in the field of data analysis and data architecture which is led by Financial Services. Interestingly, the financial sector is the leader in terms of data analysis but lags by far in terms of data integration in decision support.

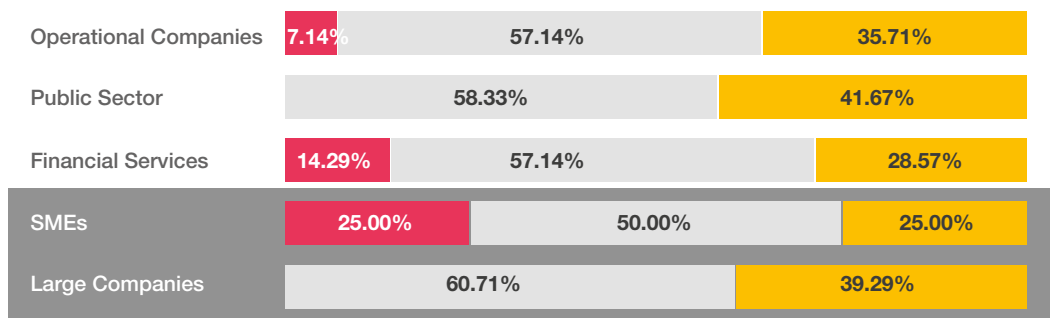
On a scale of 1 to 10, how would you rate your company in terms of maturity? (responses by sector and size)



Do you have a clear and defined strategy for managing data within your company?



Responses by sector and size

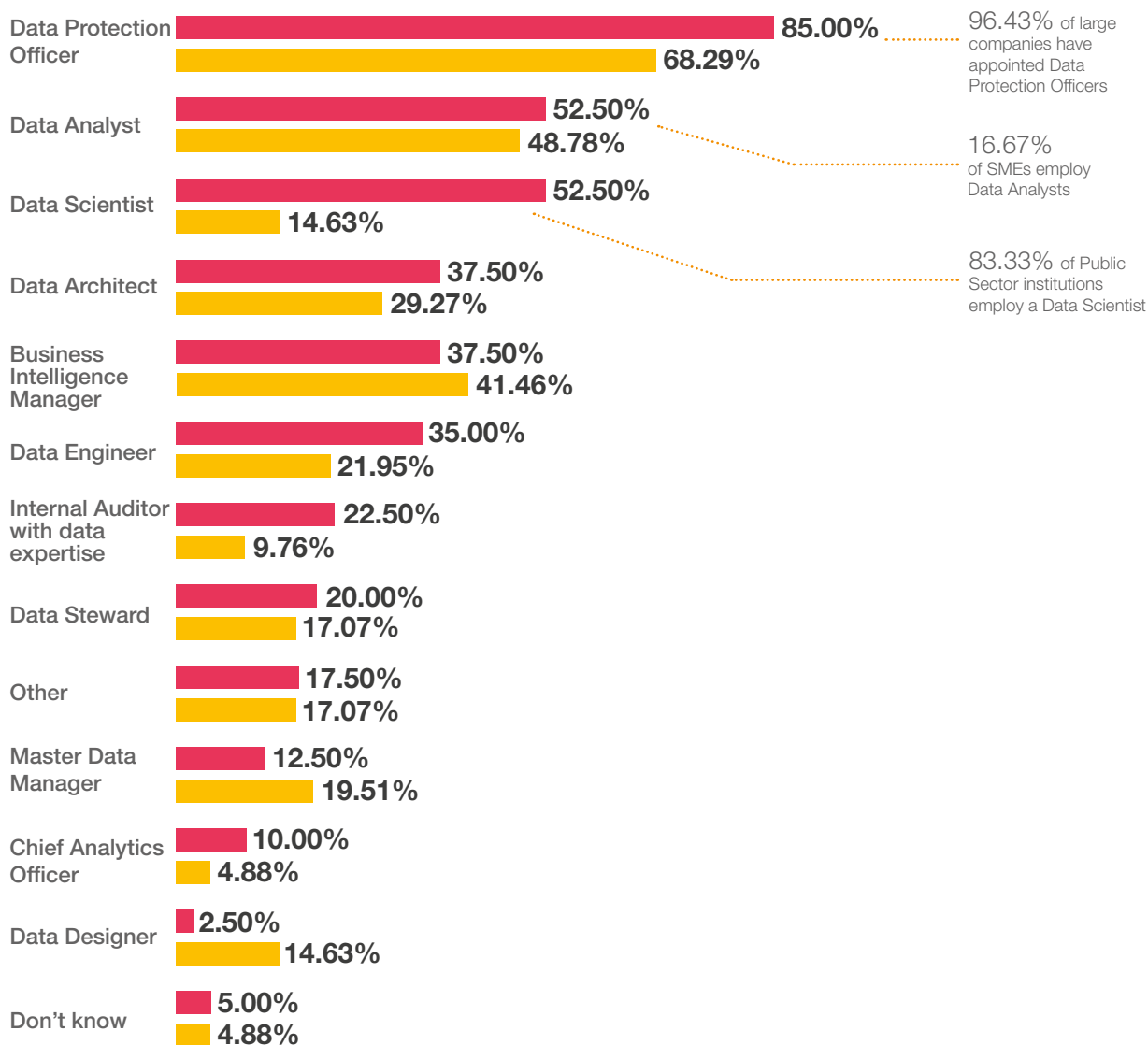


More and more Luxembourg companies are now defining a clear strategy for managing data within the company. This metric can be linked to the requirements of GDPR or even a simple realisation of the benefits of it.

No large company lacks a clear and defined strategy to manage data, even though the process is often not concluded. It is apparent that the financial sector is lagging behind.

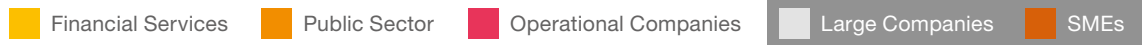
Similarly all Public Sector firms have either already formulated a clear and well defined strategy to manage data or are in the progress to do so.

Which data-related positions are there in your company?

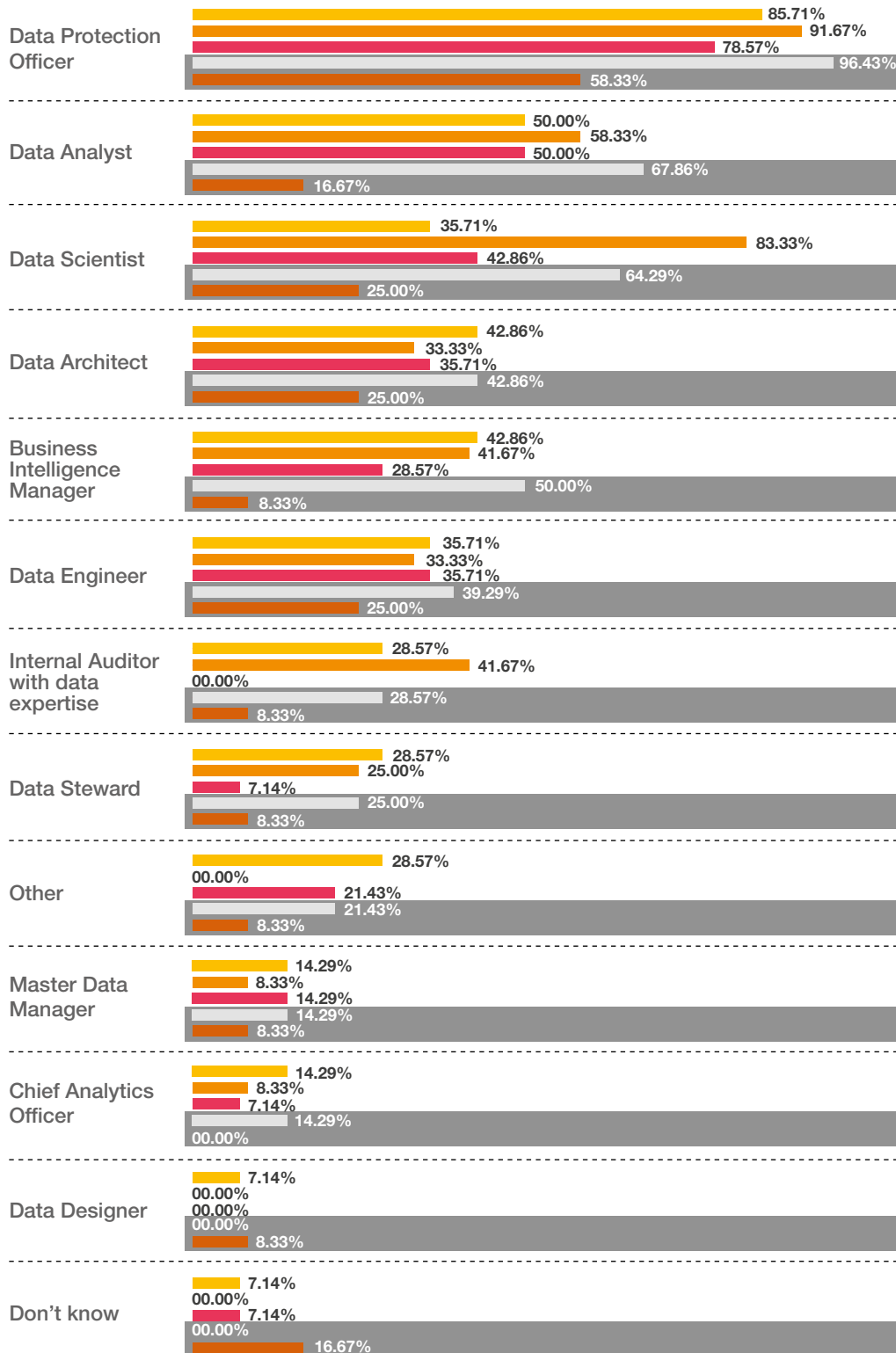


The Data Protection Officer continues to be the most prominent data-related role in Luxembourg companies, rising over 15+ percentage points from 2019 while Data Analysts and Data Scientists have become the second most sought after role by companies.

Data Scientists have increased their representation tremendously from 2019, going from a mere 14.63% to 52.50% in just 2 years. This increase has been overwhelmingly led by the Public Sector by employing more than twice the average of private companies. Apart from that, the results are very consistent across the three industries. But the results are very different if we compare large companies with SMEs, which could be explained by the lower number of employees.

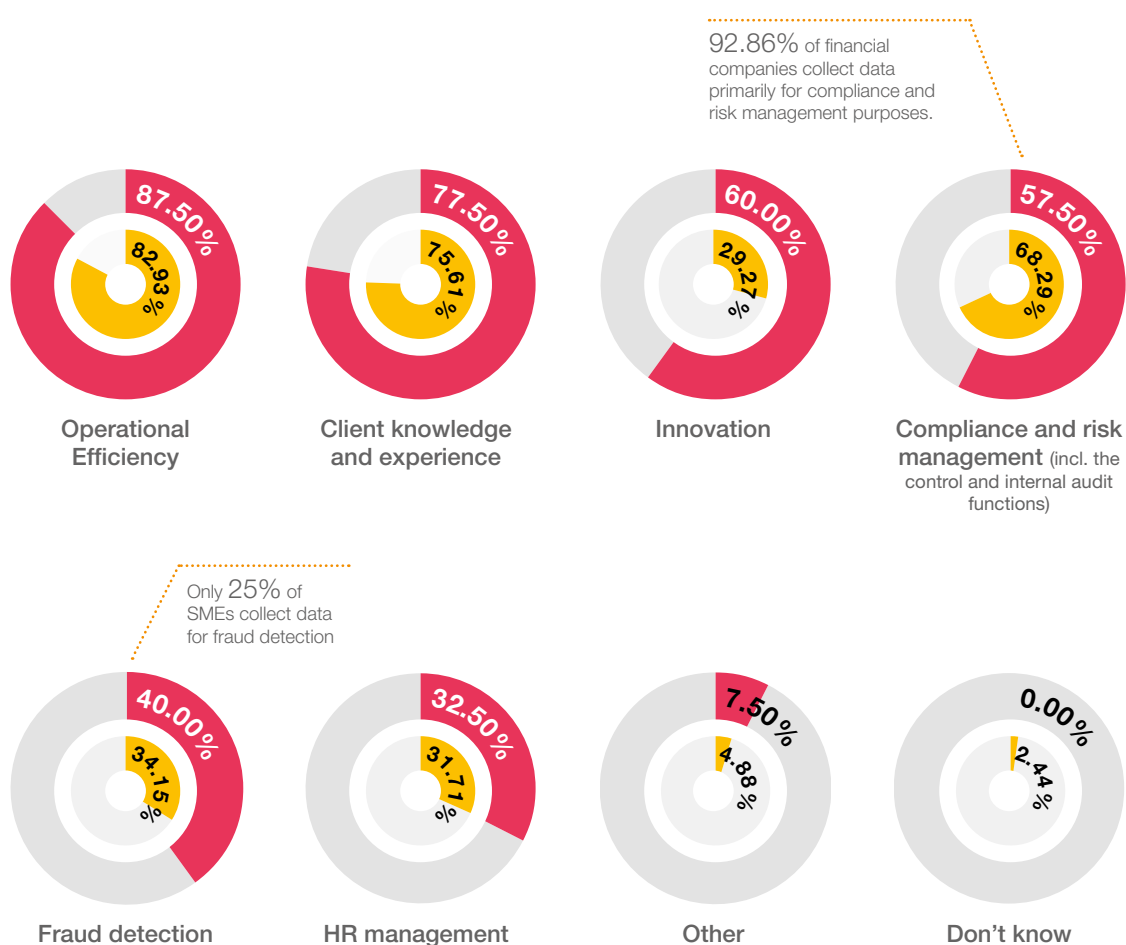


Which data-related positions are there in your company? (responses by sector and size)



Data Collection and Use

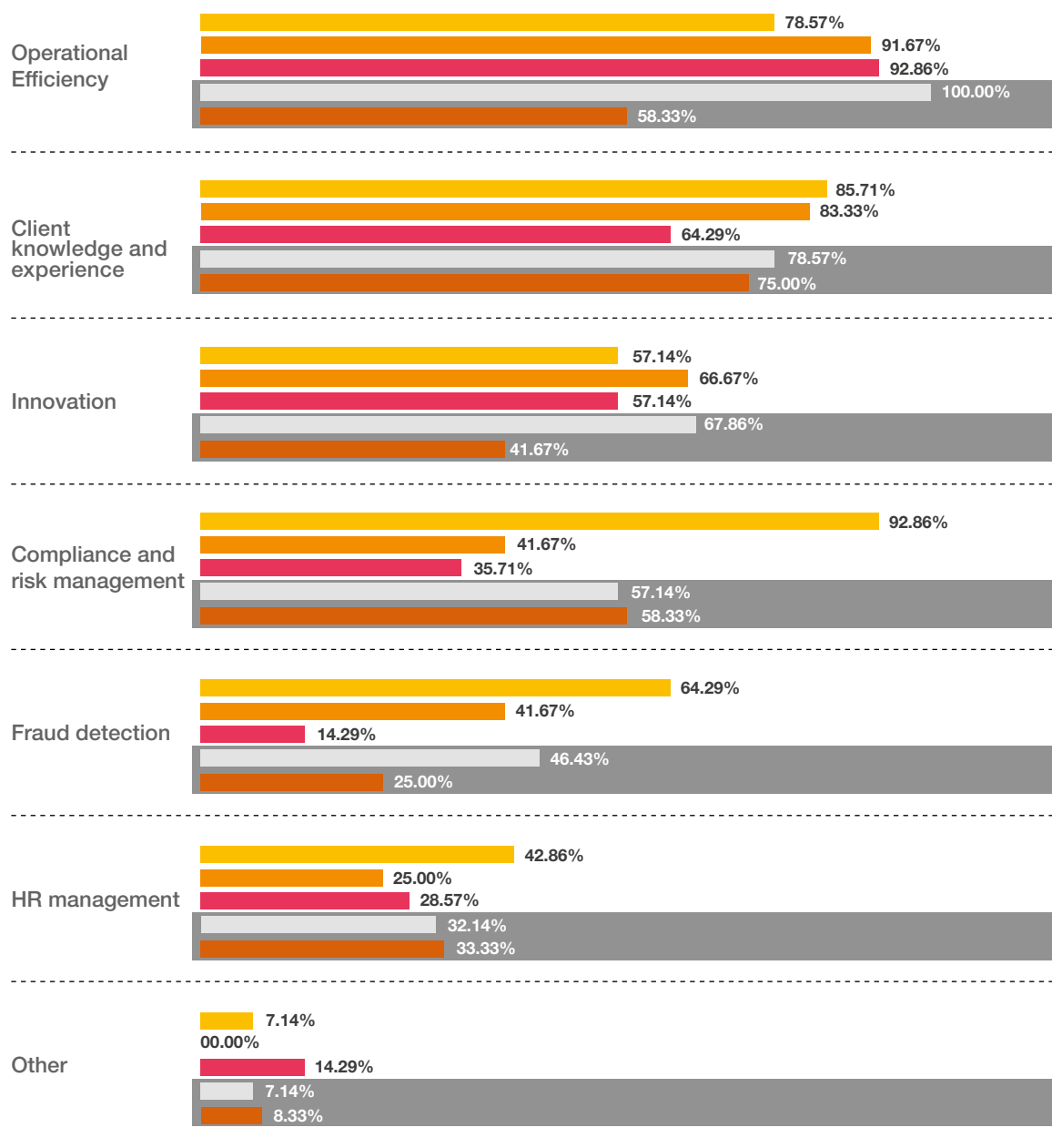
What are your main reasons for collecting data?



Data collection for operational efficiency and client knowledge and experience remains the highest in Luxembourg companies whereas that for Innovation has more than doubled since 2019. This demonstrates the willingness of Luxembourg companies to explore new opportunities through data.

Compliance and risk management is the only category where data collection has fallen since 2019. This is a category that is by far the most dominant in Financial Services.

What are your main reasons for collecting data? (responses by sector and size)

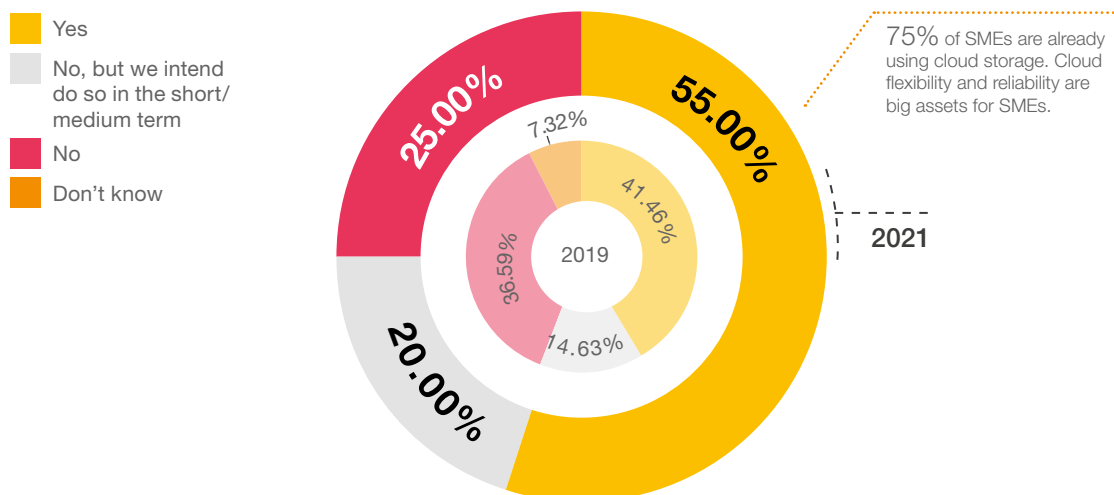


Don't know

No participants selected this option in either group

Cloud

Do you store some of your data on the cloud?



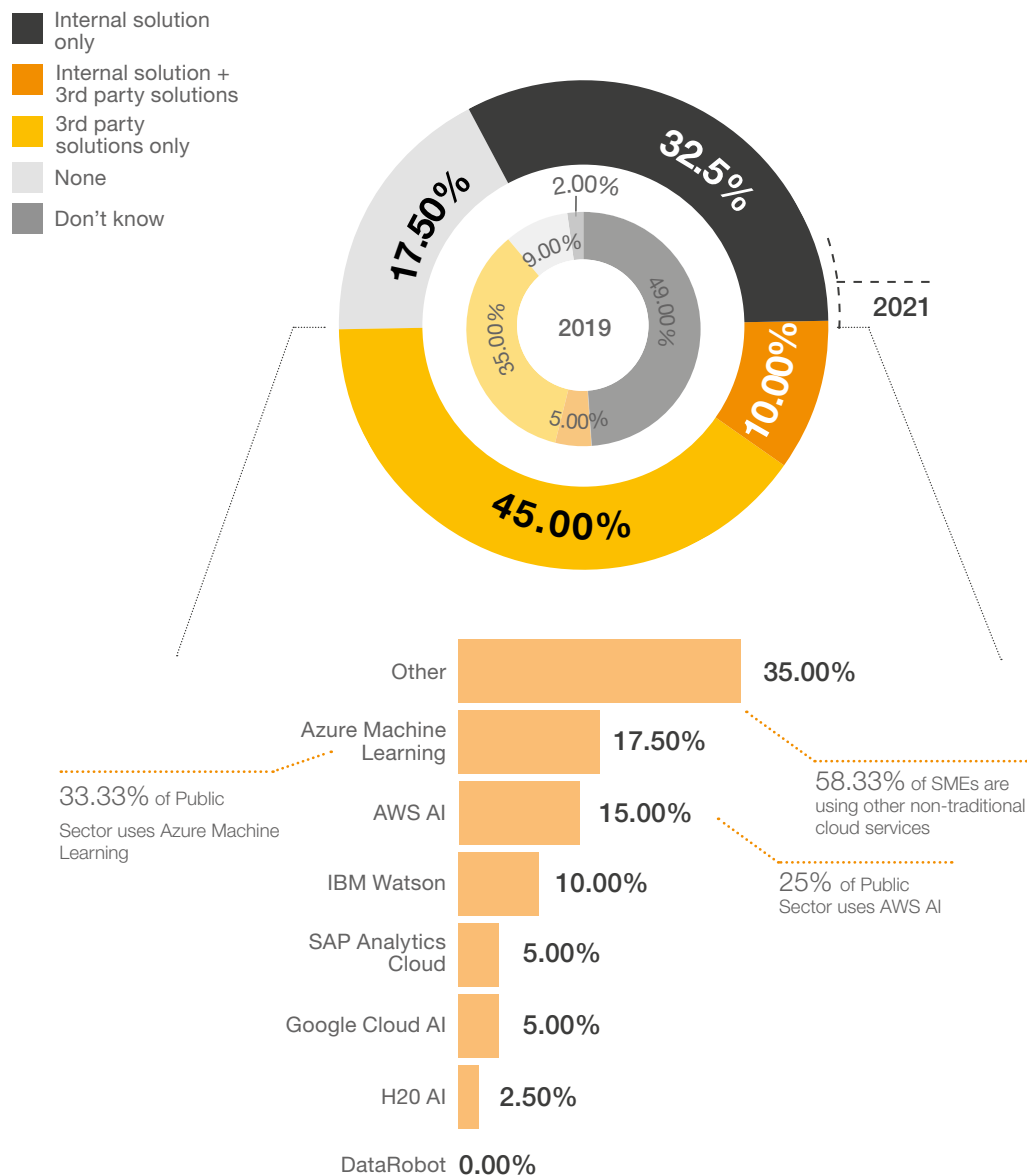
Responses by sector and size

Operational Companies	35.71%	64.29%	
Public Sector	33.33%	66.67%	
Financial Services	35.71%	28.57%	35.71%
SMEs	25.00%	75.00%	
Large Companies	25.00%	28.57%	46.43%

Luxembourg companies have witnessed a very good acceptance of cloud storage, specially over the last two years.

The adoption of cloud has been faster among SMEs with 75% of companies already employing cloud storage services. Among larger companies, about 46% are already using cloud storage and another 29% have plans to join them. This would mean cloud storage as a concept is equally attractive to companies of all sizes.

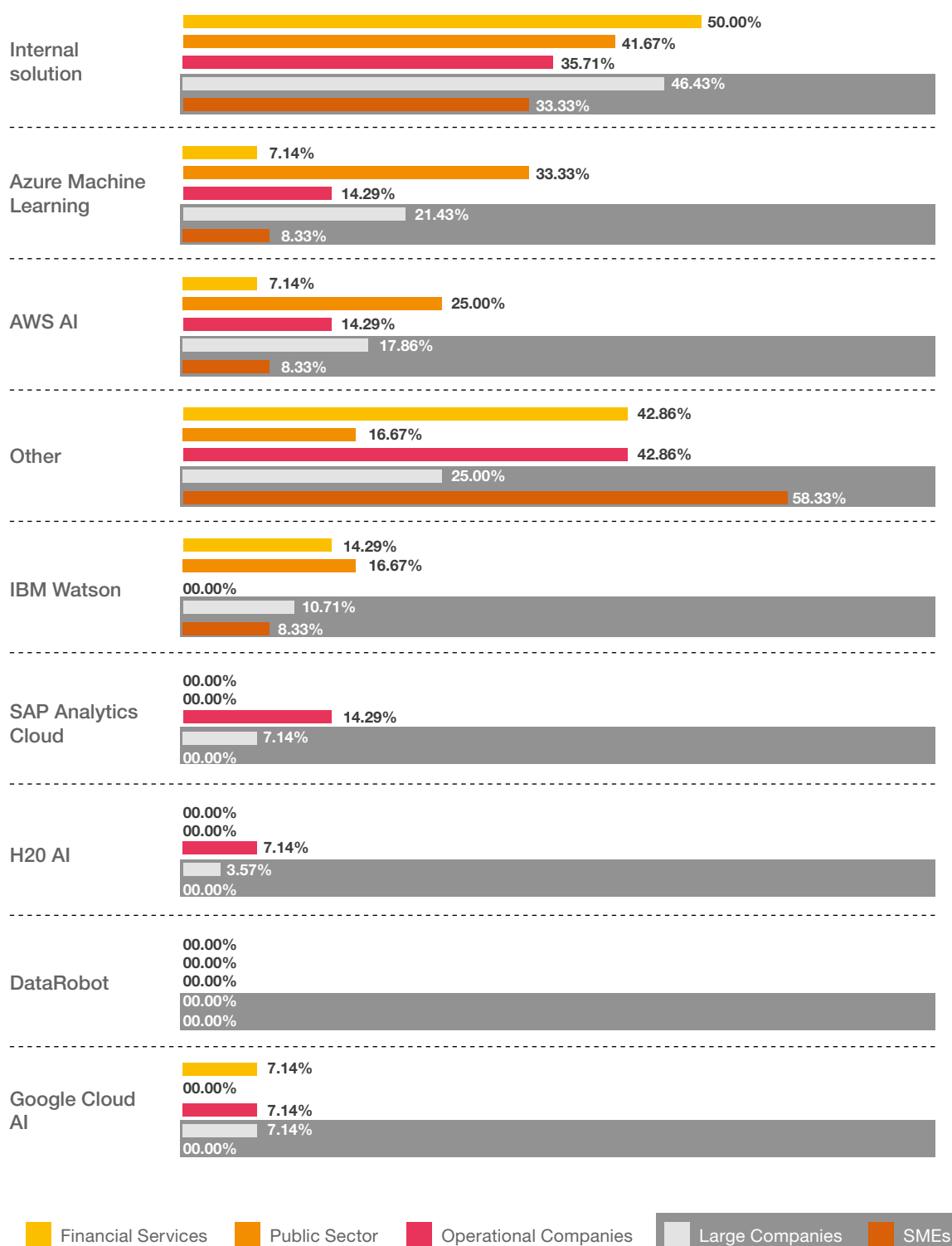
Which AI cloud platforms do you use?



There is a clear shift in two years towards companies reaching out to external expertise for their AI solutions and requirements as the utilisation of 3rd party AI cloud platforms has increased from 40% of the companies in 2019 to about 50% in 2021.

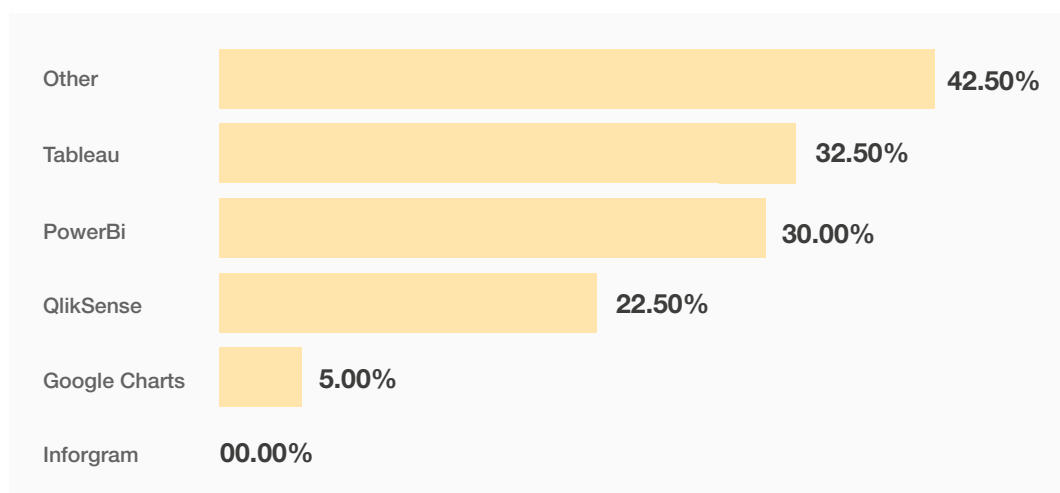
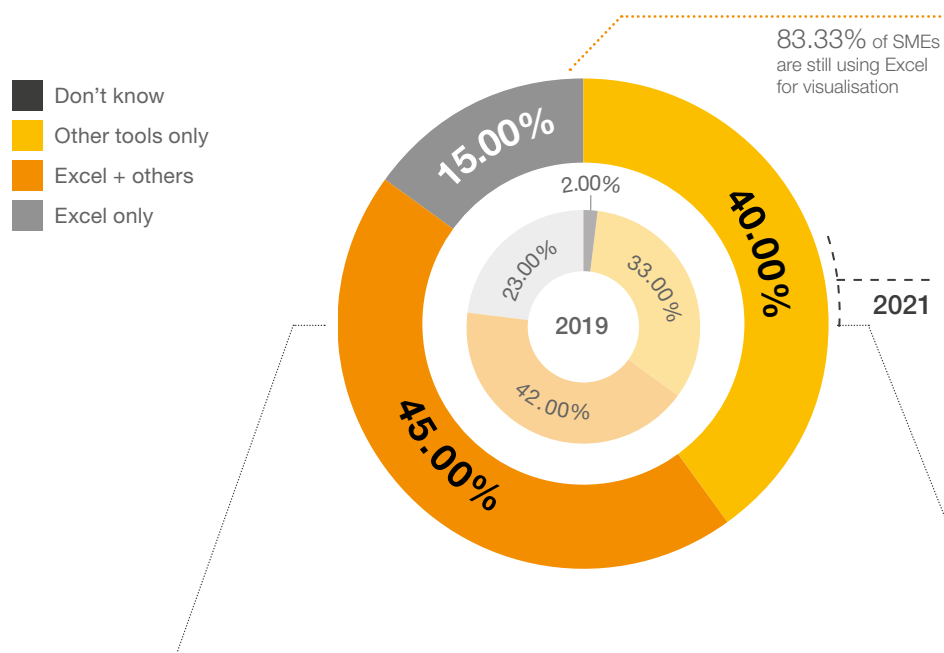
50% of companies in Financial Services, however, are still dependent on Internal Solutions and 43% on non-traditional AI solutions, which means that cloud is used for infrastructure only and specific AI technologies are implemented. Public Sector partners the most with traditional AI service providers such as AWS, Azure and IBM.

Which AI cloud platforms do you use? (responses by sector and size)



Visualisation

Which visualisation tool(s) do you use?

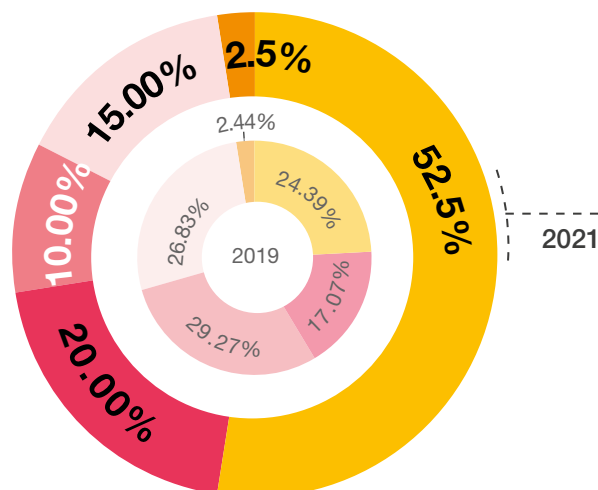
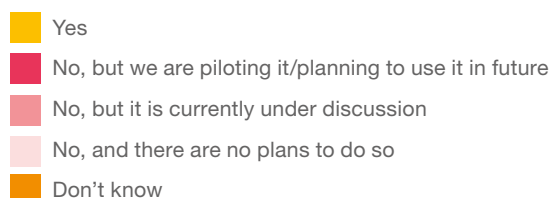


Although Excel remains the most popular for visualisation, more and more Luxembourg companies are moving towards more specialised tools such as PowerBI and Tableau since 2019.

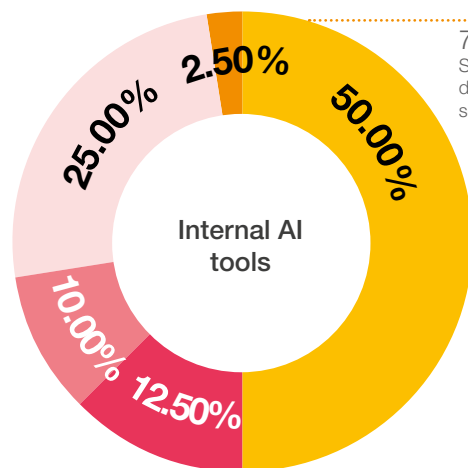
SMEs are a lot more dependent on Excel for visualisation compared to large companies.

Artificial Intelligence (AI)

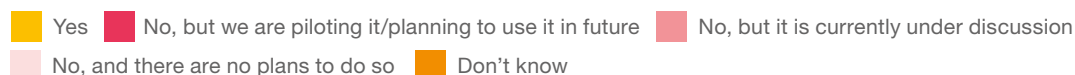
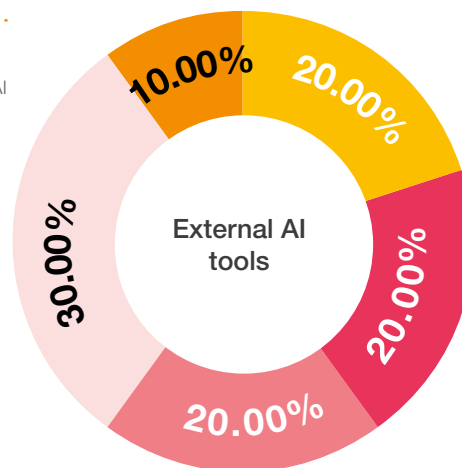
Are you currently using AI tools?



Are you currently using internally developed AI tools (e.g. self-developed machine learning algorithm with Python) or external AI tools (e.g. DeepL for translation, Ephesoft Transact for document analysis) in your company?



75% of Public Sector has already deployed Internal AI solutions



Luxembourg companies have moved quite far ahead in two years in incorporating AI tools into their operations.

We asked for the first time on the category of AI tools that they are using, if they are self-developed or sourced externally.

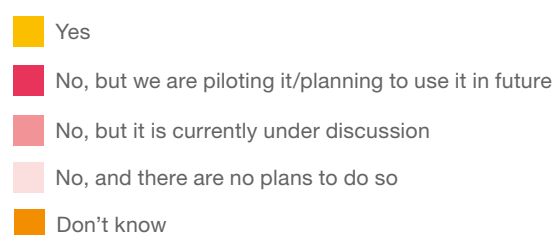
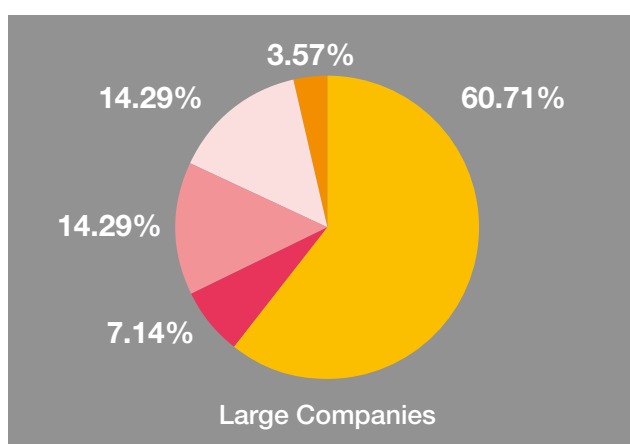
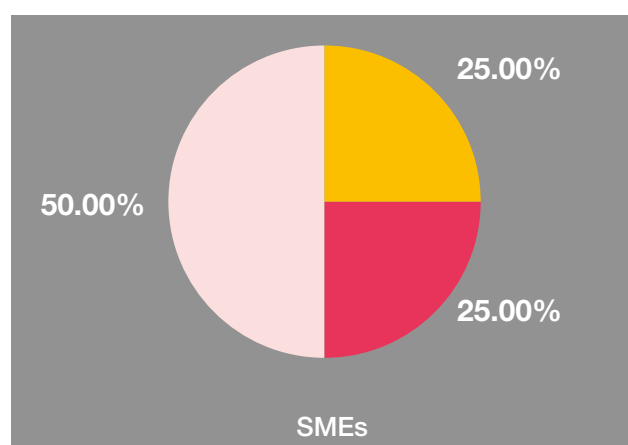
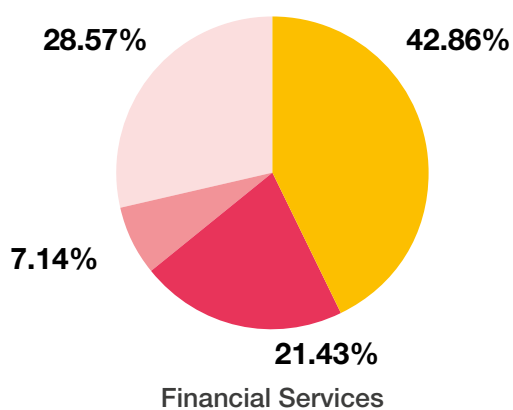
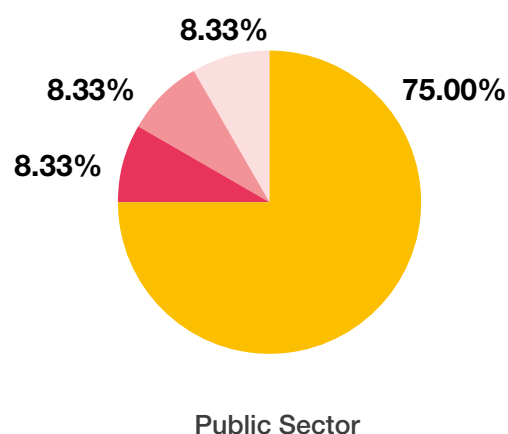
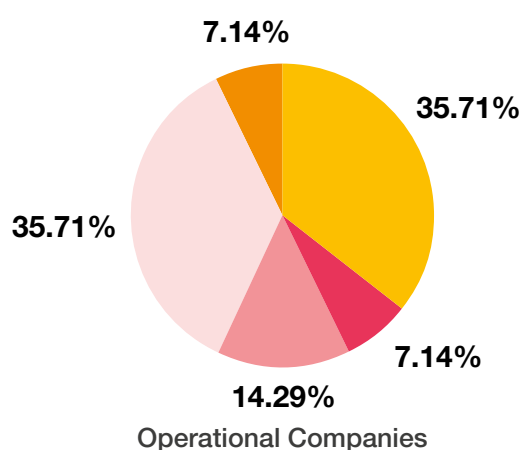
There has been more effort and intentions in Internal AI tools as compared to external ones.

The Public Sector has shown the most interest in using AI tools, especially developing them internally with similar intentions to accept external expertise.

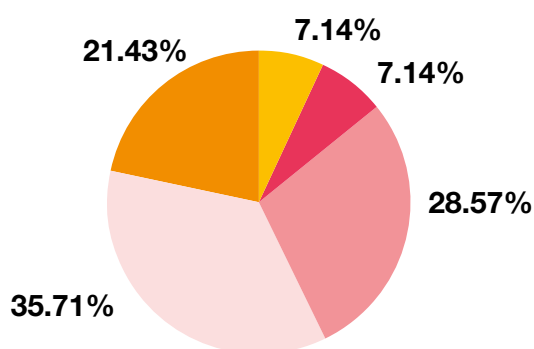
Operational Companies are lagging behind despite many use cases of AI and huge potential for innovation.

Large companies show a lot more attraction and intention for using AI tools when compared to SMEs.

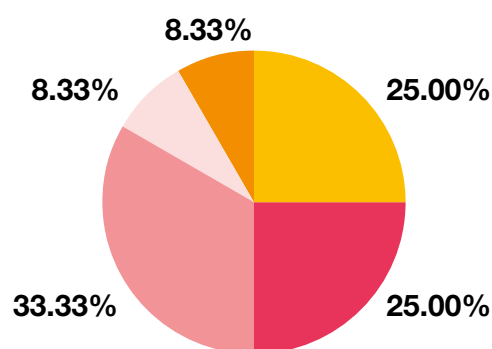
Are you currently using internally developed AI tools (e.g. self-developed machine learning with Python) in your company (responses by sector and size)?



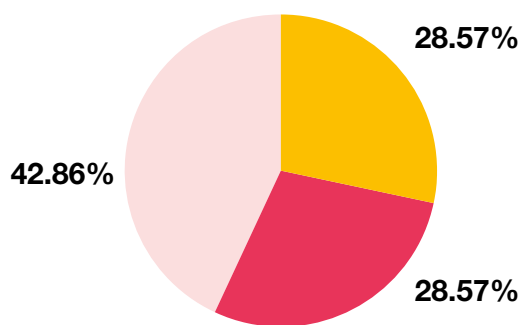
Are you currently using external AI tools (e.g. DeepL for translation, Ephesoft Transact for document analysis) in your company (responses by sector and size)?



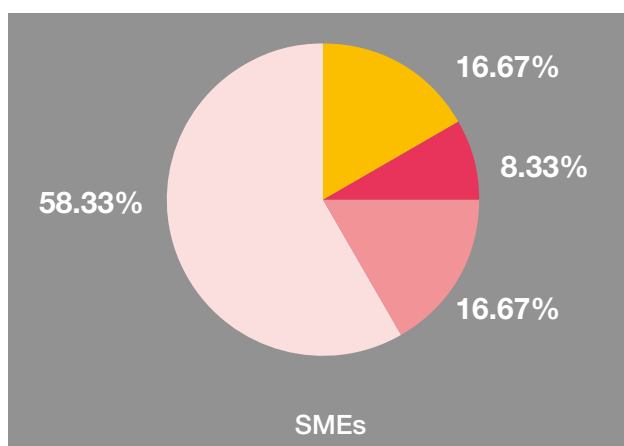
Operational Companies



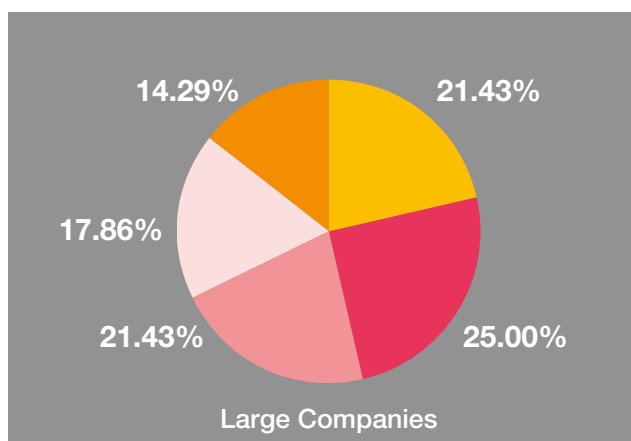
Public Sector



Financial Services



SMEs



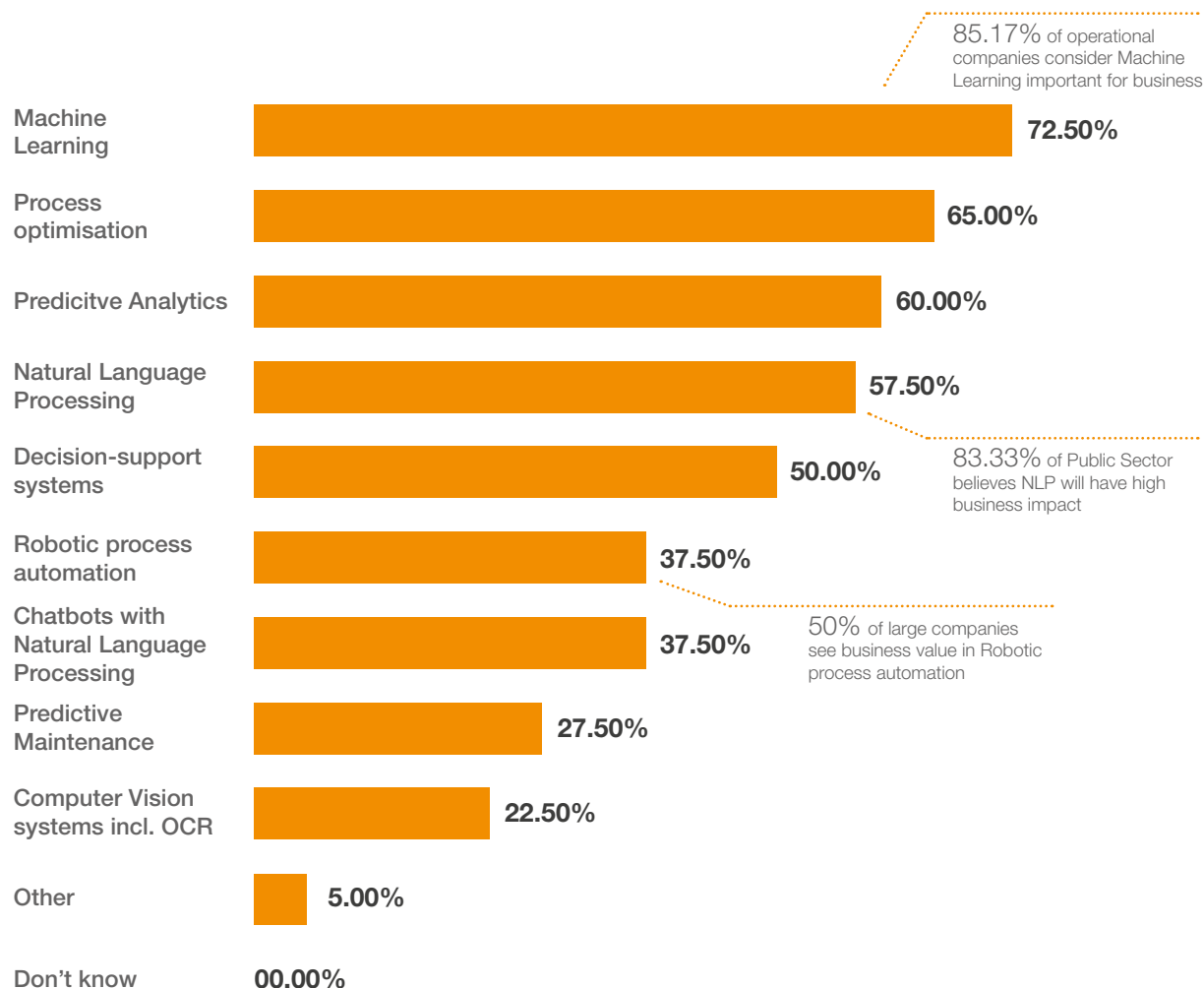
Large Companies

- Yes
- No, but we are piloting it/planning to use it in future
- No, but it is currently under discussion
- No, and there are no plans to do so
- Don't know

There are stark differences in the adoption and usage of AI tools in large companies and SMEs. SMEs lack technological know-how and the capability to employ AI tools.

Business impact

Which AI-related concepts do you think have or would have the greatest impact on your business?



In order to assess the business impact of different AI technologies, we asked for the first time how Luxembourg companies think about this aspect.

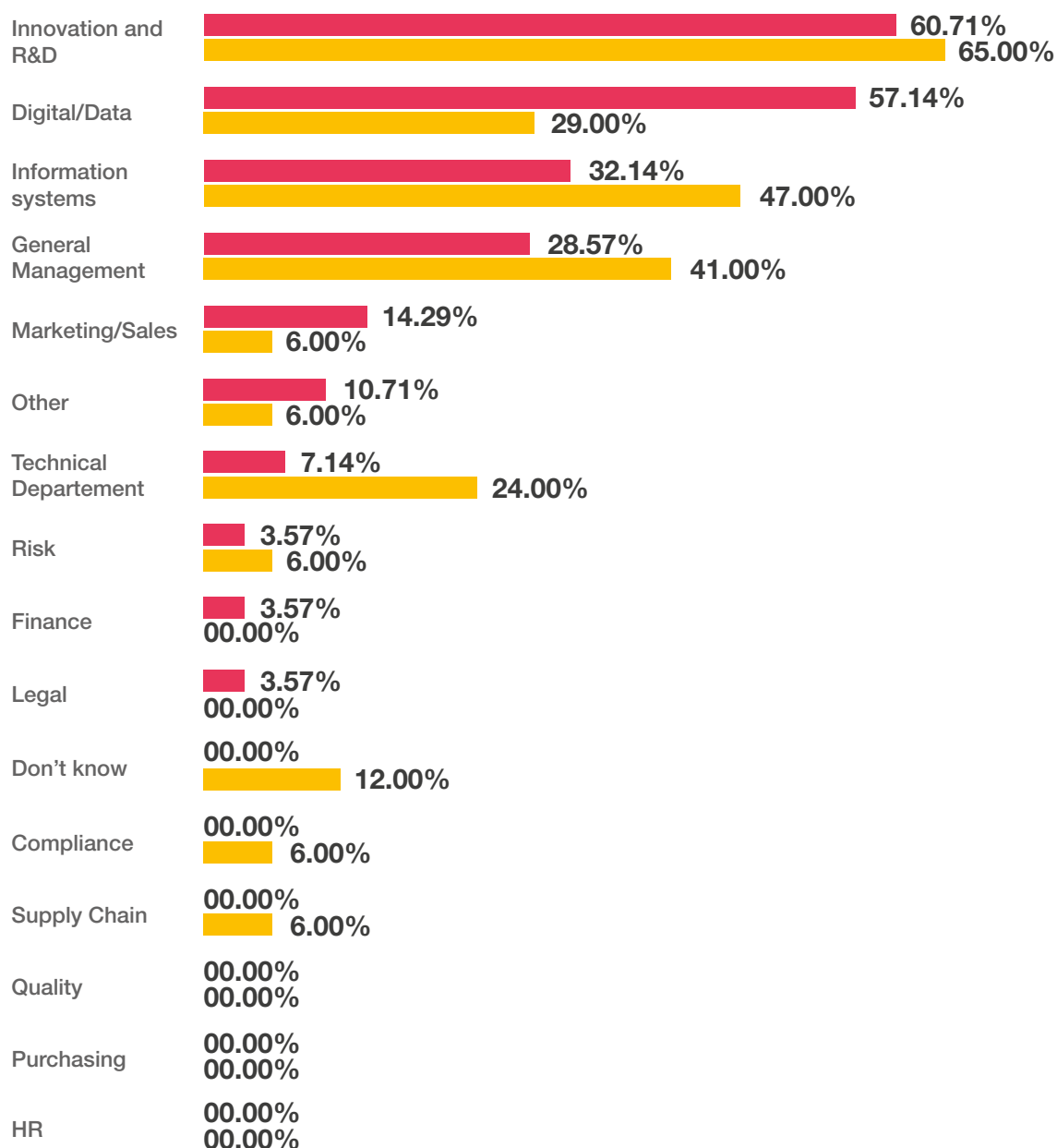
Machine learning is the highest business impact field of AI among Luxembourg companies, most notably for operational companies, where more than 85% see a high impact.

Robotic process automation has a varied response, with 75% of the public sector seeing a high relevance, while for financial services and operational companies it is around 35%.

Large companies see a significantly higher value in predictive analytics to manage business of scale, compared to SMEs.

Teams

Who is/are responsible for piloting AI-related projects within your company?

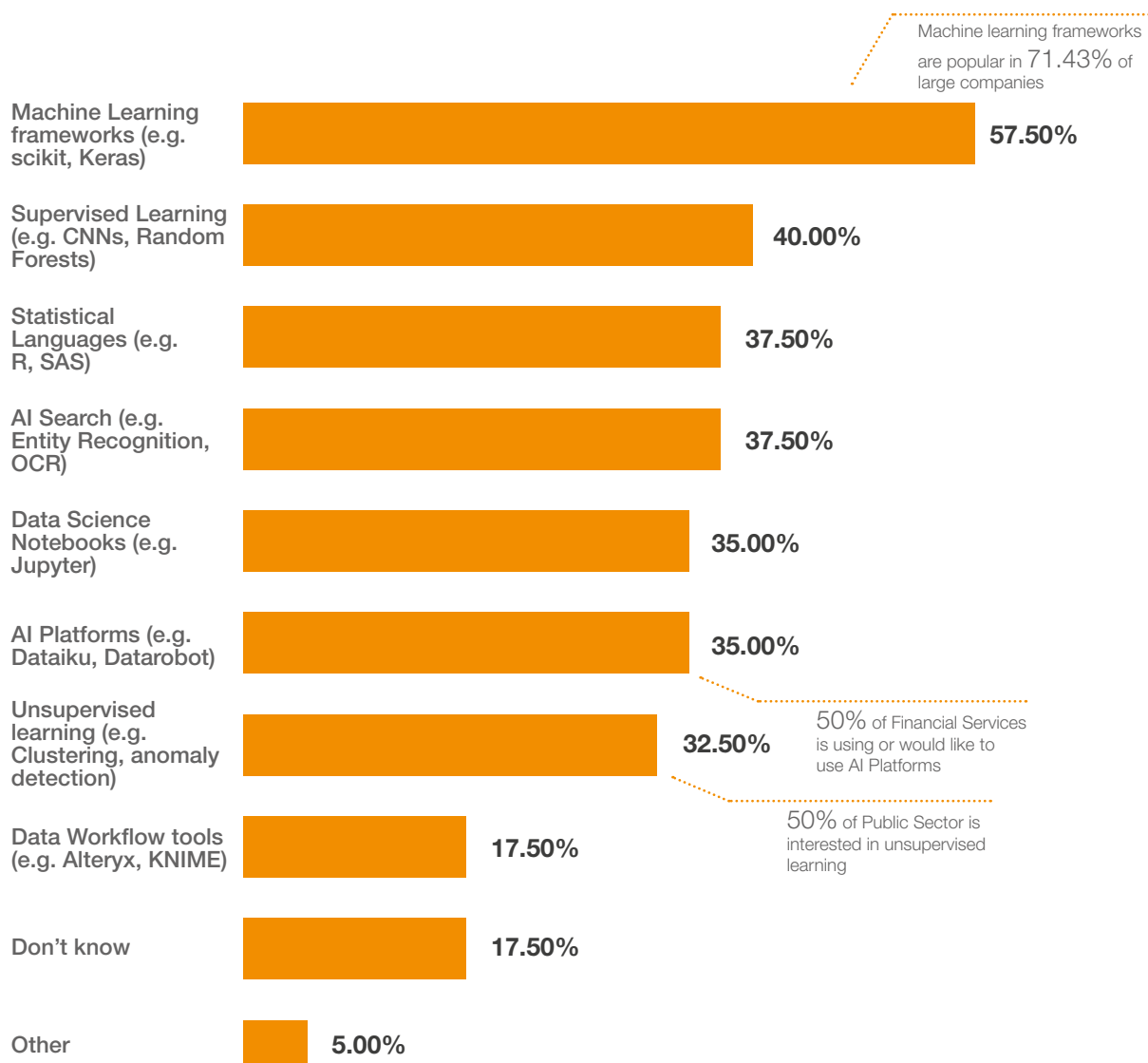


The most significant shift in leading AI projects has been the Digital/Data team incorporating AI as a subset of its own. AI projects by Digital/Data teams have increased to almost double of that in 2019.

There is a clear shift of AI projects and initiatives from R&D to business and dedicated data teams as AI becomes more accessible through modern tools.

Technologies and techniques

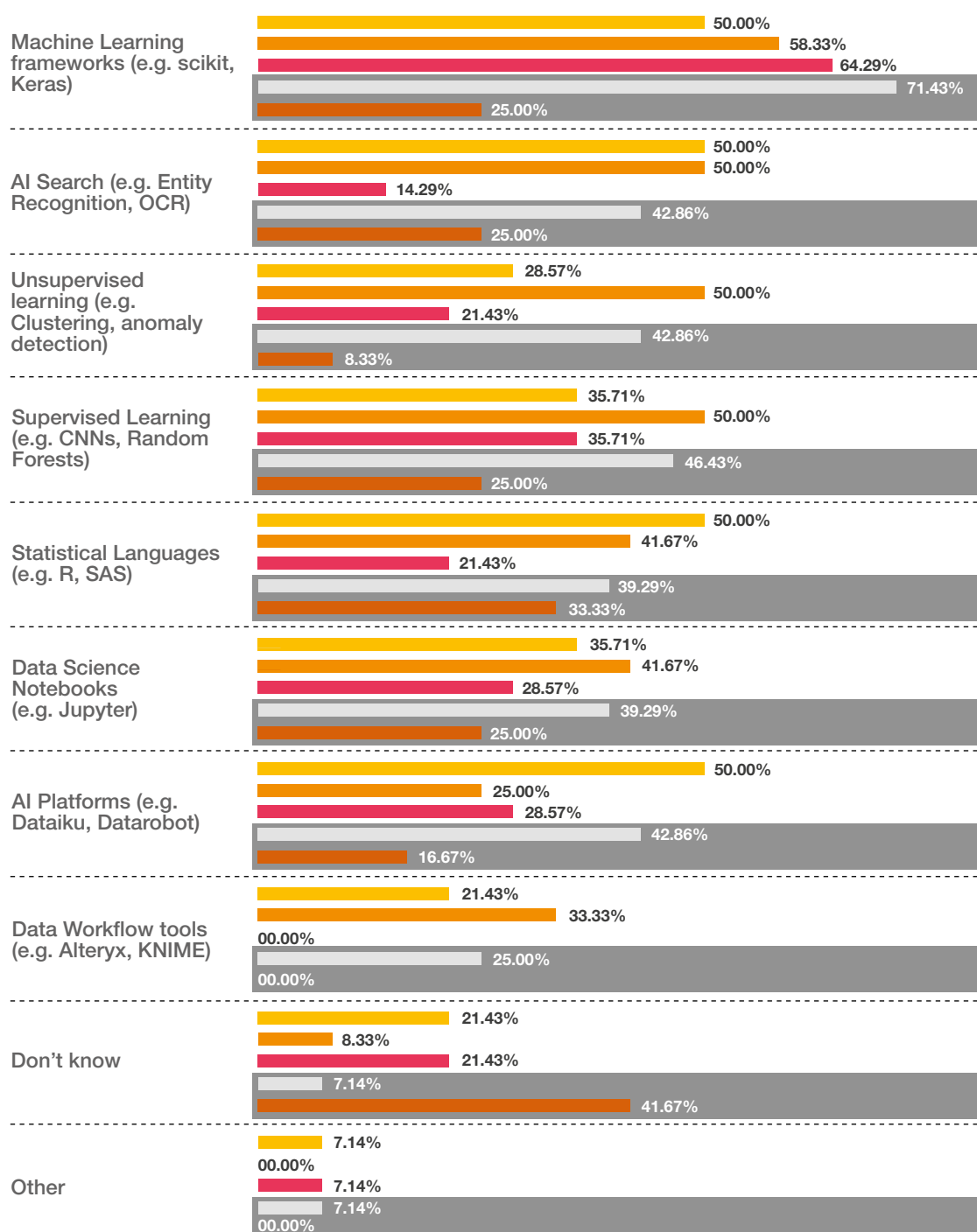
Which AI technologies are you using or would like to use?



The knowledge on AI tools is more exposed in large companies compared to SMEs in Luxembourg. This can be explained by increased maturity of data science teams in larger organisations that effectively leverage new technologies.

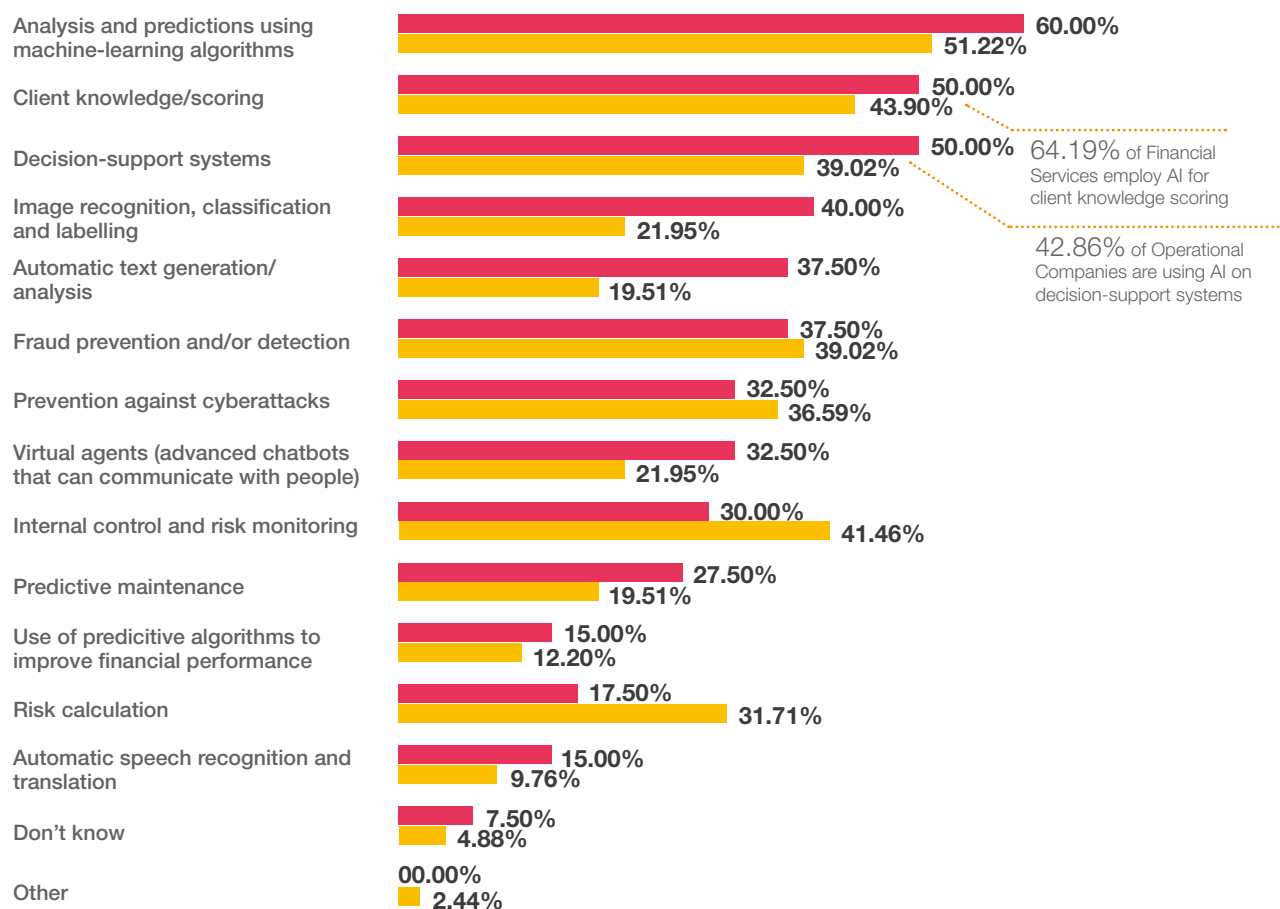
As the tool landscape in AI shifts so rapidly, we did not include a comparison to the 2019 responses on this question.

Which AI technologies are you using or would like to use? (responses by sector and size)



Field applications

In which fields is AI used (or would be used) within your company?



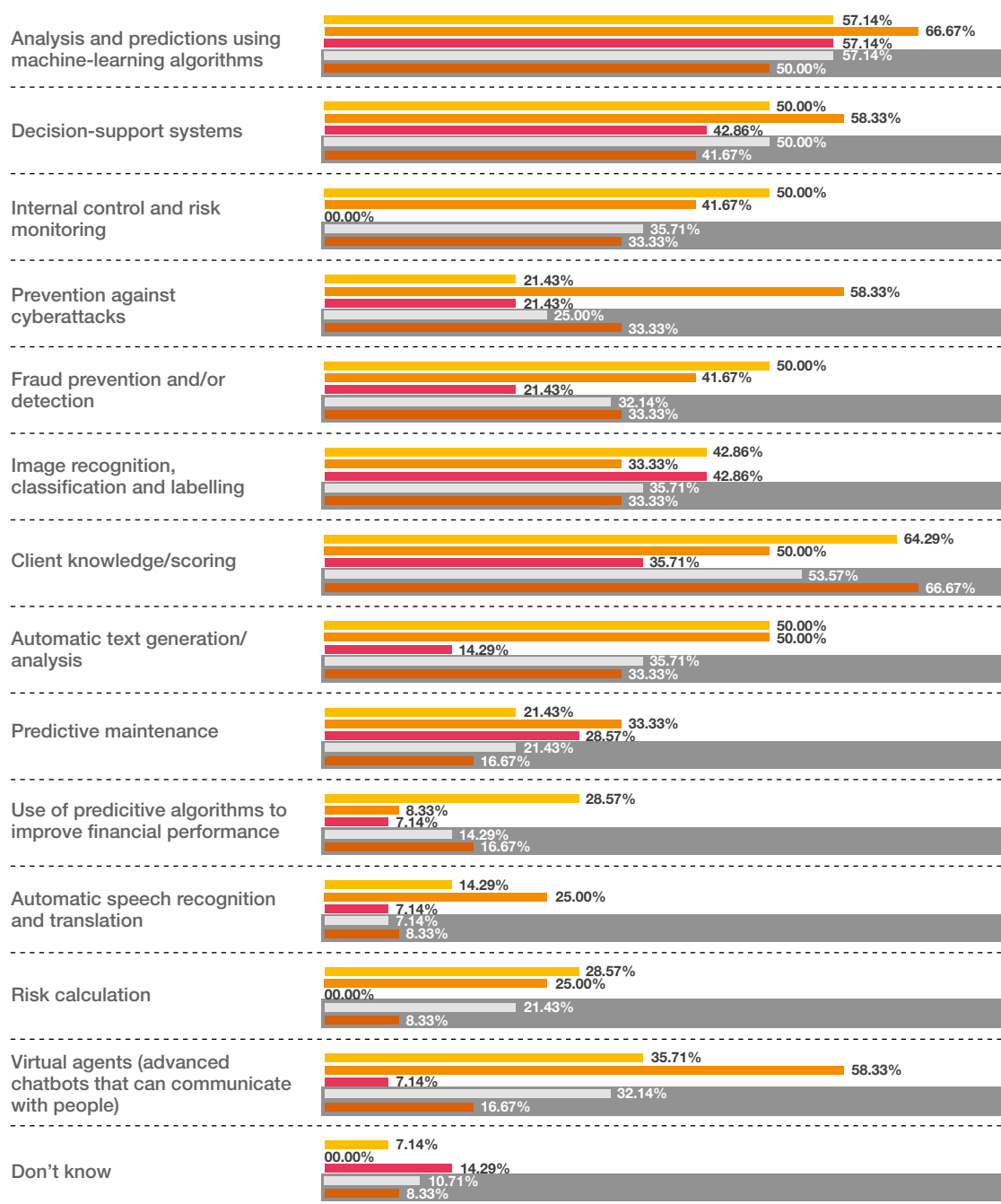
Analyses and predictions, as well as deriving decisions from them are the major motivators to use AI in Luxembourg companies.

There is a shift from functional to business oriented AI. It has moved from categories such as compliance, regulatory, fraud, cyber etc towards more business focused categories such as prediction and client knowledge. Similarly, image recognition on documents has gained popularity to further automate mundane tasks and relieve workforces for more productive pursuits.

The Public Sector, thanks to its heavy investment in AI tools among the sectors, is leveraging AI for improving protection against cyber threats.

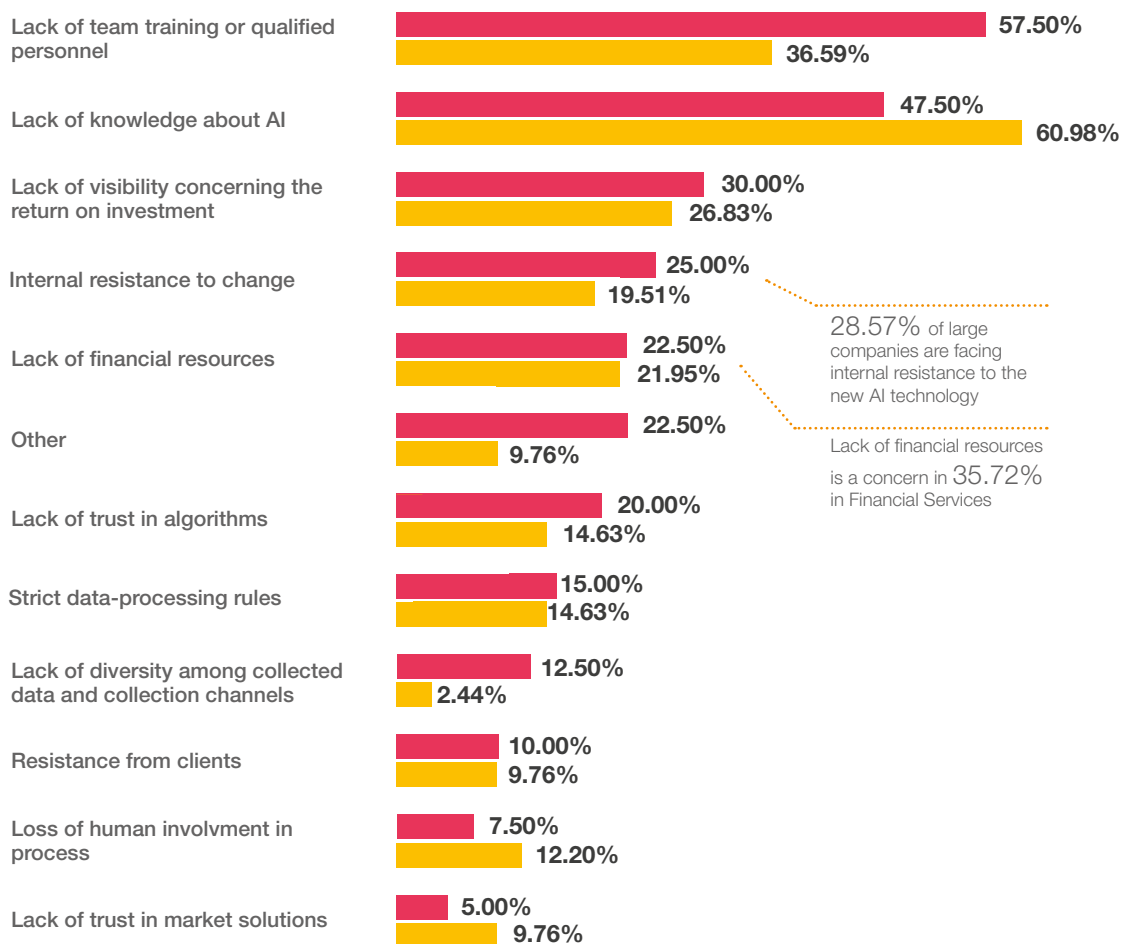
Financial Services is most interested in using AI for client knowledge/scoring and is the most advanced in predictive algorithms to improve financial performance. On the other hand, operational companies are investing their resources predominantly into analysis and prediction, decision-support, cyber security and internal controls.

In which fields is AI used (or would be used) within your company? (responses by sector and size)



Facing hurdles

What do you think are the reasons for not deploying AI?

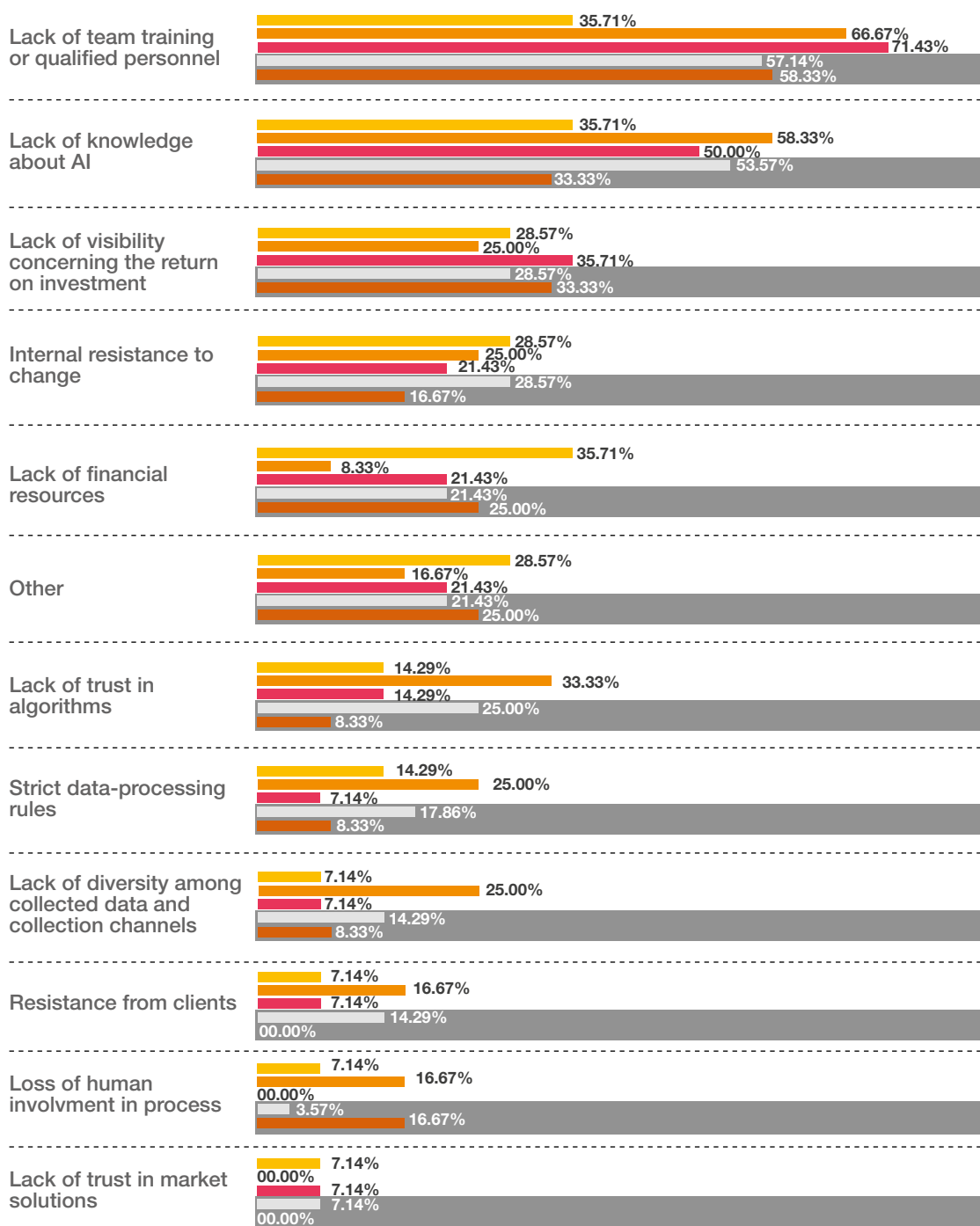


The biggest inhibitor to growth of AI in Luxembourg is the lack of qualified individuals and the knowledge of AI. This is a trend across sectors and size of companies.

The knowledge on AI has increased and the lack there of is no longer the main detractor in using AI. There remains significant room for improvement on AI knowledge.

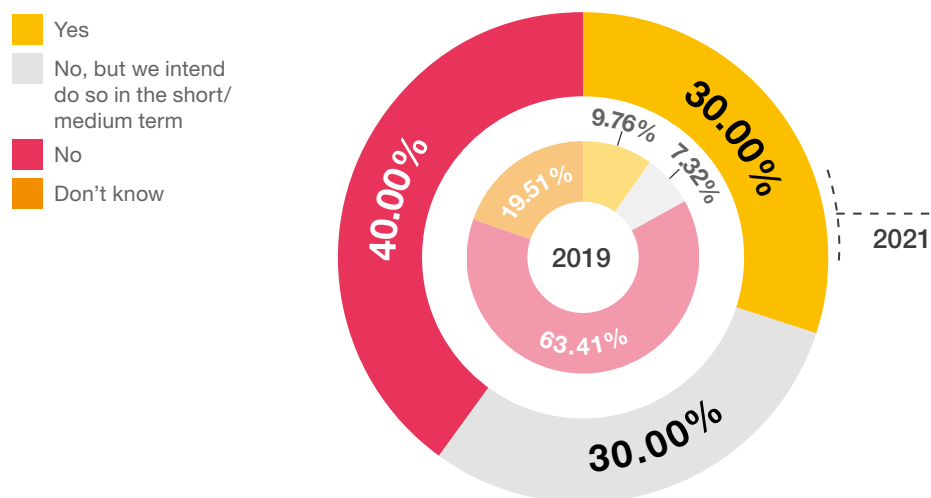
Moreover, the lack of visibility on the return on investment has also been a major inhibitor to the progress of AI in Luxembourg. This is a trend common in companies of all sizes.

What do you think are the reasons for not deploying AI? (responses by sector and size)



Deployment monitoring

Do you have follow-up indicators to measure the impact of deploying AI in your company's field of business?



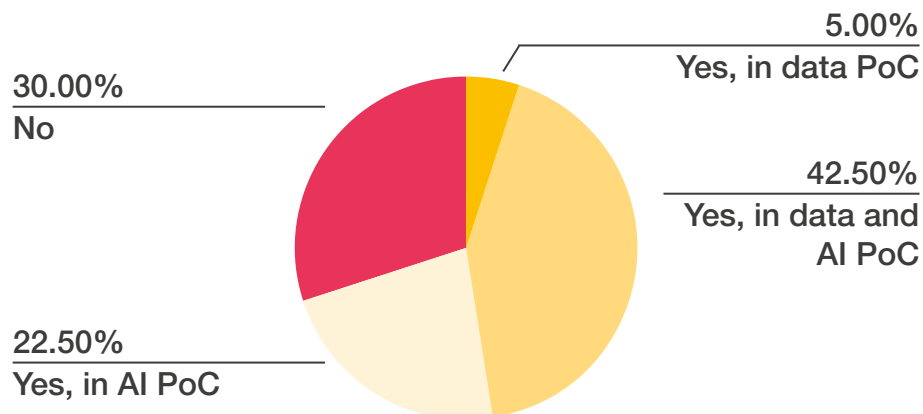
With the rise of AI among Luxembourg companies, there has also been a rise in monitoring its impact on business.

This area has become more relevant on the agenda of Luxembourg companies.

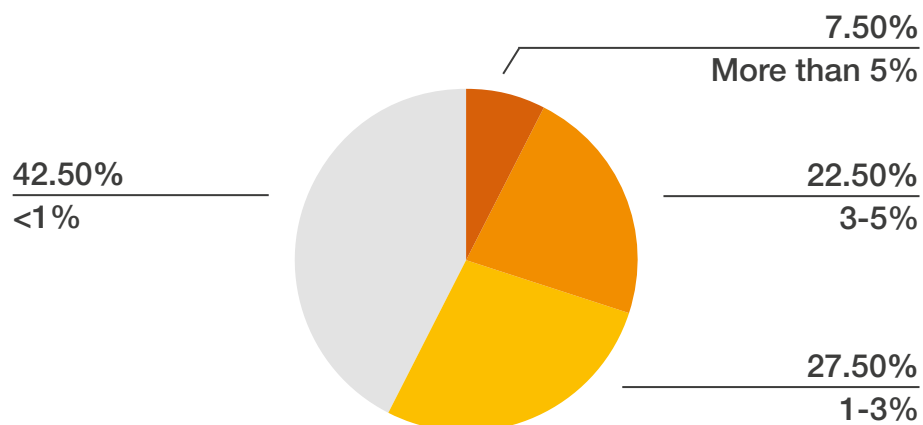


Investment

Have you invested - or are you considering investing - in proofs of concept?



What percentage of your turnover would you allocate or be prepared to allocate to develop/improve data or AI solutions?



For the first time this year, we also inquired about investment in AI.

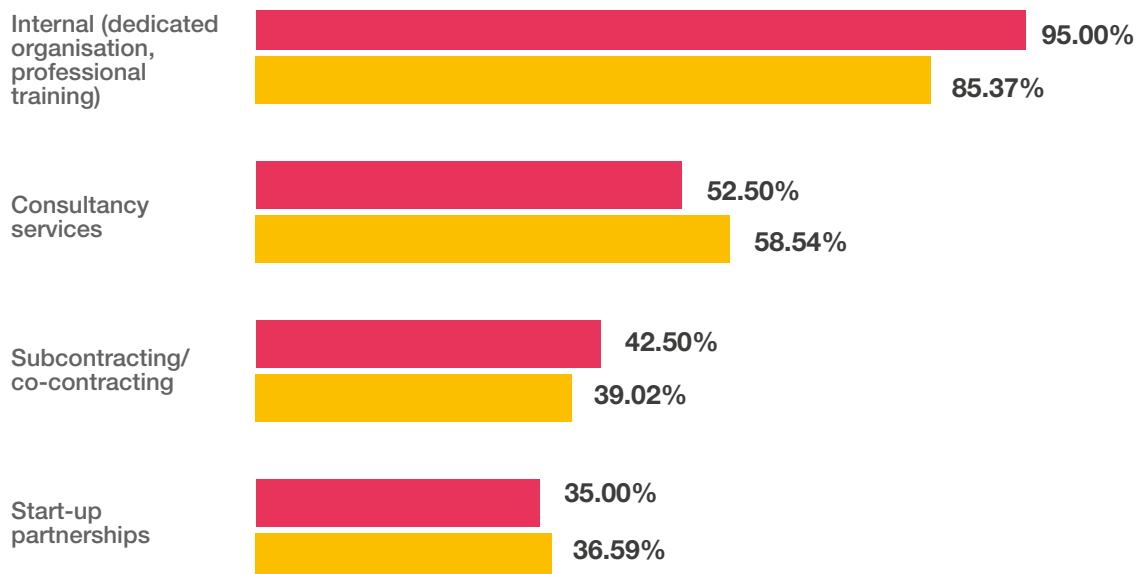
Among Luxembourg companies there is a high willingness to engage in research on Data and AI as is evident by a total 70% investment rate in PoCs on the topics.

This is well complemented by the fact that about 30% of the companies consider investing over 3% of their turnover into the development of Data and AI solutions. Whereas, another 27.50% consider investing between 1% and 3%. This is a significant number, showing the growing interest.

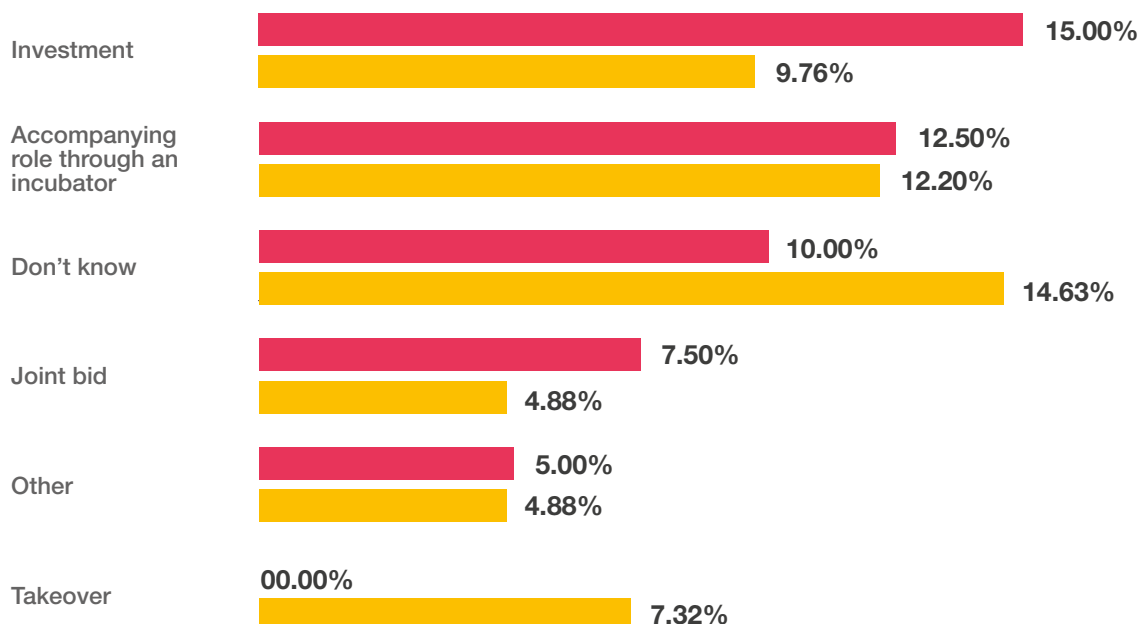
According to the Financial Times in 2019, these numbers support Luxembourg's Data and Innovation strategy for the future as in the present Luxembourg ranks 4th in the world in AI investment per capita.

Collaboration

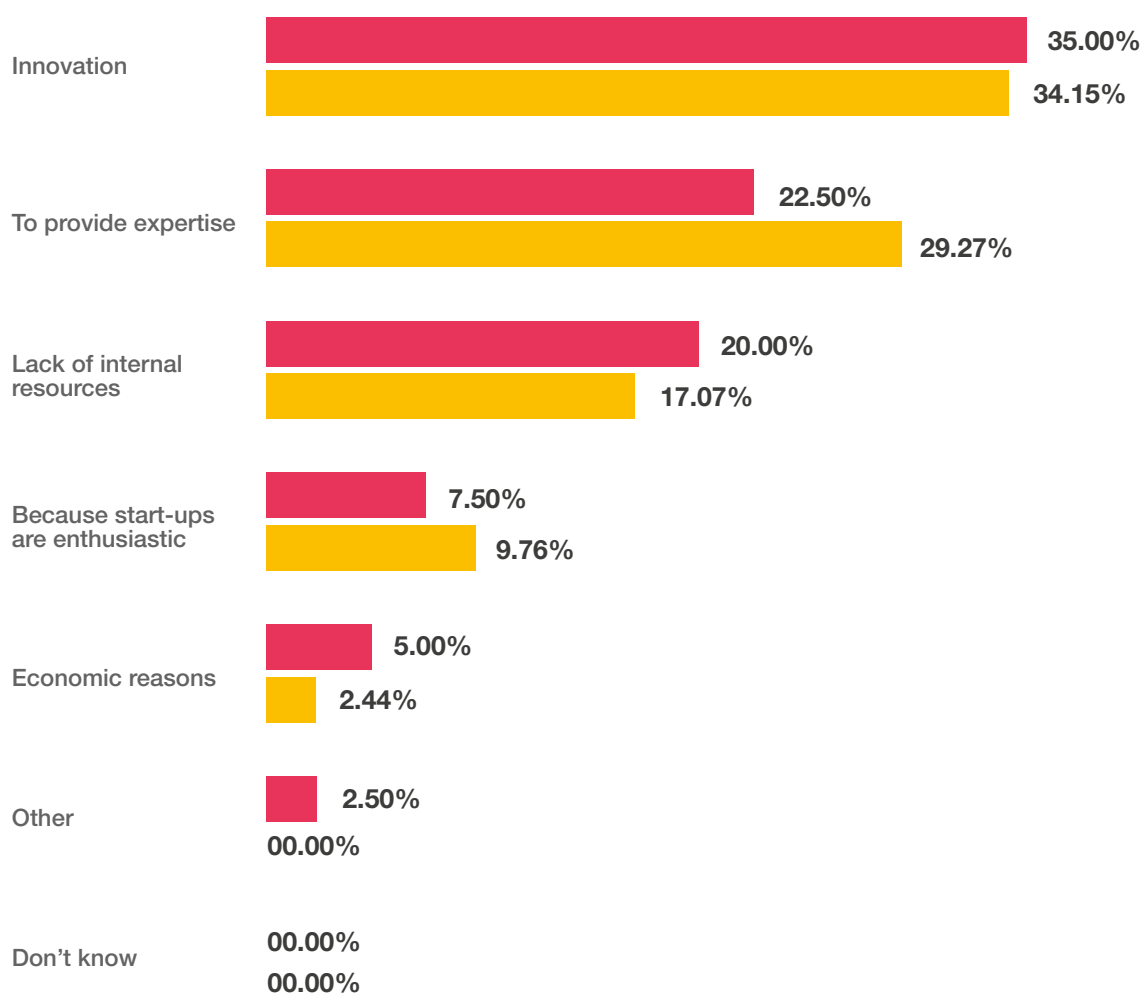
Which of the following actors are/would be involved in developing data solutions within your company?



What collaboration method(s) have you chosen/would you choose with start-ups?



Why do you/would you get start-up partnerships involved in developing data solutions within your company?



Luxembourg companies have slightly moved away from employing expertise from consultancy firms and have focused more on internal alternatives since 2019.

Although there is a slight drop in start-up partnerships, nevertheless investment as a way of collaboration with start-ups has seen a sharp rise.

Methodology



Survey methodology

Questionnaire

This survey was conducted on-line by PwC Luxembourg through a self-administered questionnaire. It is based on a set of questions originally developed by PwC France and Usine Digitale.

Data collection period

During the months of April and May 2021.

Sample size

40 respondents in total, answering in their capacities of Head of IT, Operations, Risks, Data or Digital among others. Despite the limited number of respondents, we believe that the survey results paint an informative picture of the situation in Luxembourg.

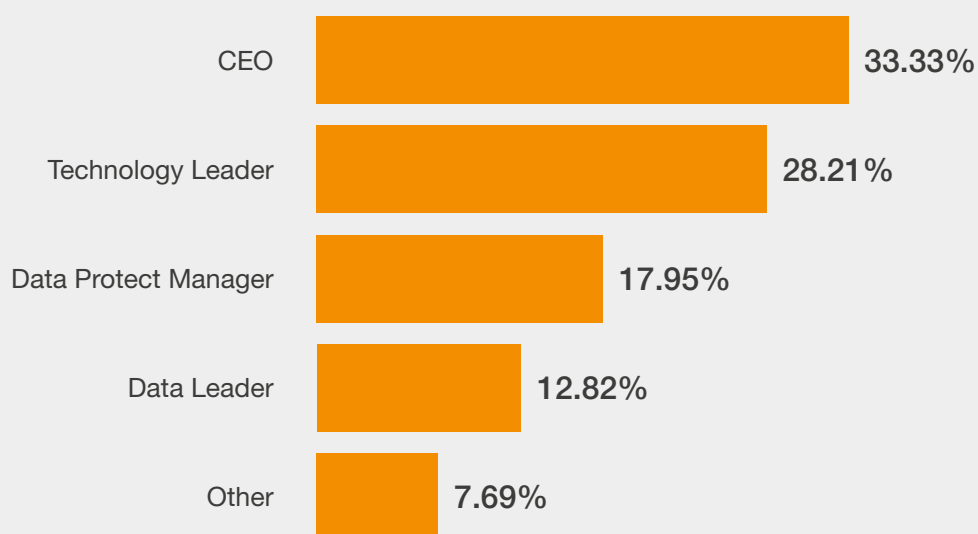
Company profiles

The companies in the sample are based in Luxembourg and come from a wide range of sectors. About 35% operate in the Financial Services, another 35% are operational companies, while the remaining 30% are Public Sector companies.

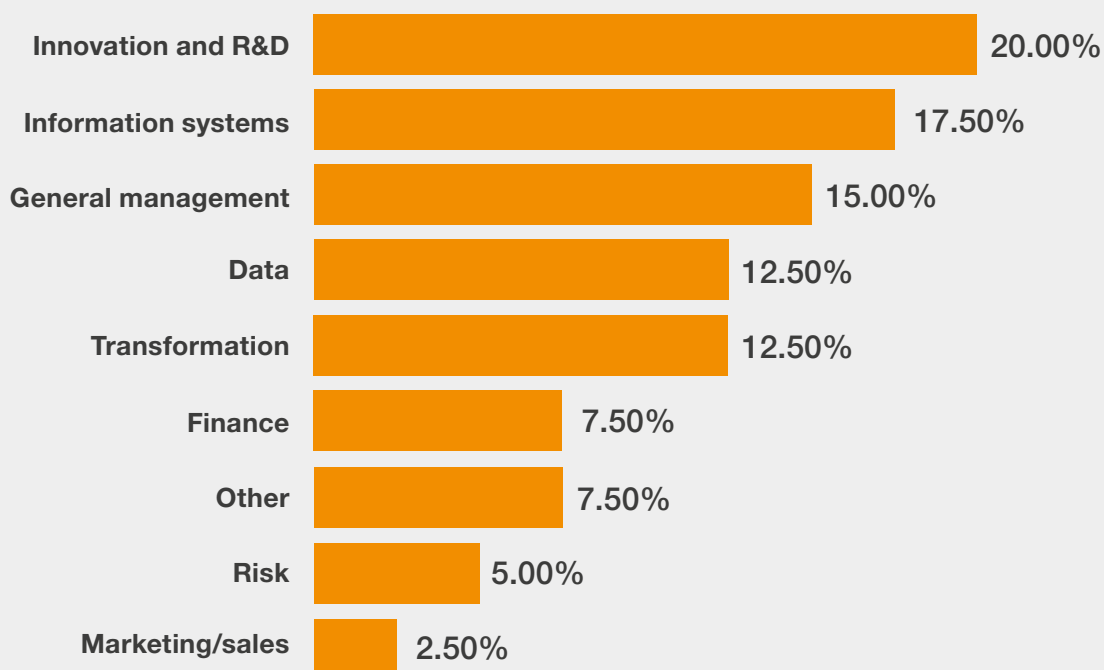
These companies are of diverse sizes: about 40% employ more than 1,000 employees while 30% are SMEs.

Respondents' profiles

Job title

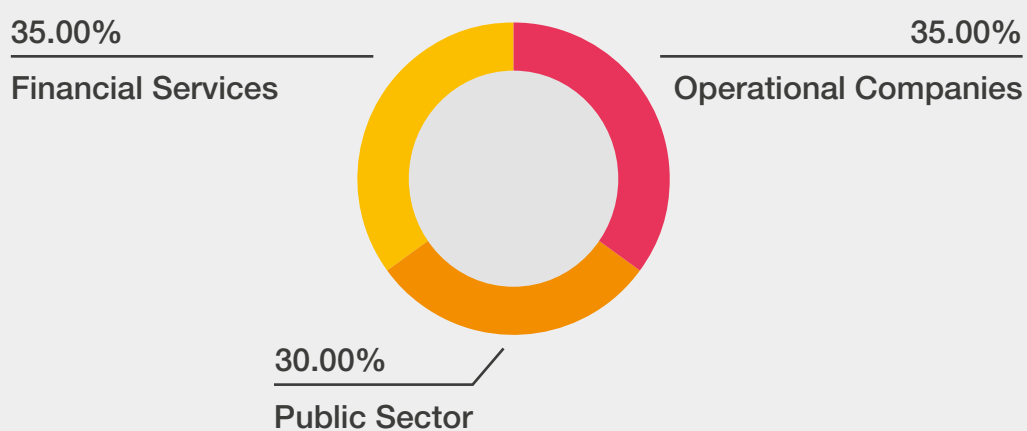


Line of business

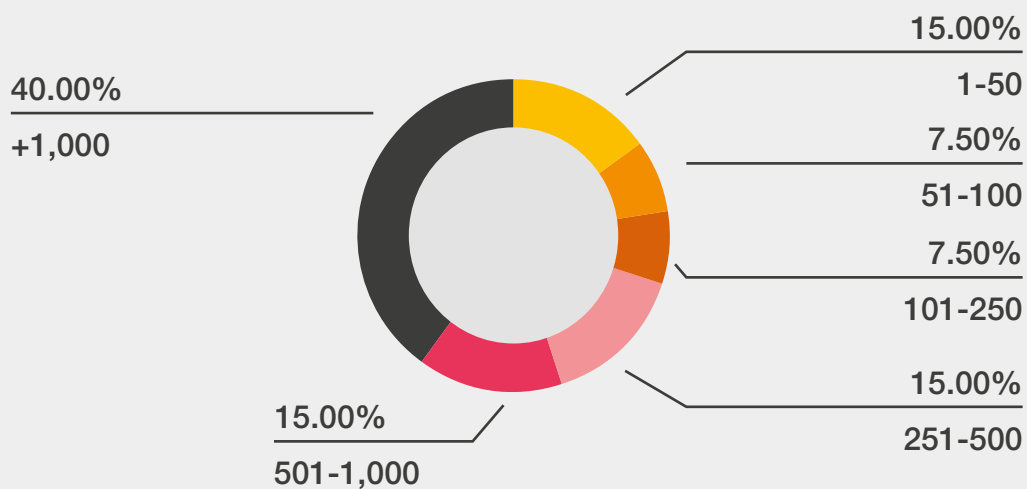


Company profiles

Business sector



Number of employees



(SME = 1 - 250 employees)

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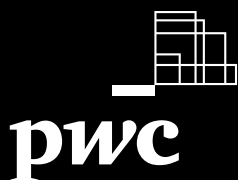
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