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# **Cloud Adoption in European Financial Markets Barriers and Way Forward**

March 2022

Politecnico di Milano, with the support of **Tata Consultancy Services (TCS)**, has been undertaking research into the current state of adoption of cloud services within the European financial market, investigating the approach taken by European financial institutions towards public cloud technology and their interest in European data infrastructure initiatives.

A survey was then submitted to experts in a selection of the most important European financial institutions (banks, insurance companies, and organizations providing financial services), with three main objectives:


- Identify the challenges and barriers of moving to the cloud (in terms of cultural values, technical issues, security and privacy regulations, and so on).
- Identify the key enablers (current and with future potential).
- Understand the way forward to address these challenges and the barriers, with the aim of establishing a new perspective angle.

## Authors

### Politecnico di Milano

The [Fintech & Insurtech Observatory](#) is the setting where we carry out research on Fintech and Insurtech at the School of Management of Politecnico di Milano. As the yardstick for digital innovation within the finance and insurance ecosystem in Italy and Europe, the Observatory's objective is to create and spread the appropriate knowledge for companies and countries to manage the changes taking place in this sector in an optimal way.

The [Cloud Transformation Observatory](#) is focused on developing and spreading knowledge to support companies in leveraging the opportunities of the cloud, as the widely-acknowledged enabler of digital transformation. The Observatory aims to analyze available technology tools and understand adoption courses, innovation opportunities, and the impact on the IT system and overall IT management as, for example, of adopting work methodologies such as Agile and DevOps.



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### Tata Consultancy Services (TCS)



Tata Consultancy Services is an IT services, consulting and business solutions organization that has been partnering with many of the world's largest businesses in their transformation journeys for over 50 years. TCS offers a consulting-led, cognitive powered, integrated portfolio of business, technology and engineering services and solutions. This is delivered through its unique Location Independent Agile™ delivery model, recognized as a benchmark of excellence in software development.

A part of the Tata group, India's largest multinational business group, TCS has over 556,000 of the world's best-trained consultants in 46 countries. The company generated consolidated revenues of US \$22.2 billion in the fiscal year ended March 31, 2021 and is listed on the BSE (formerly Bombay Stock Exchange) and the NSE (National Stock Exchange) in India. TCS' proactive stance on climate change and award-winning work with communities across the world have earned it a place in leading sustainability indices such as the MSCI Global Sustainability Index and the FTSE4Good Emerging Index. For more information, visit [www.tcs.com](http://www.tcs.com).

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## Executive Summary

### About cloud computing

Cloud computing is a key enabler for digital innovation in financial institutions (FIs). Companies can readily access a set of configurable resources via the internet, which are provided by the cloud service provider (CSP), thereby radically changing their IT operations, and paving the way for digital transformation and new business opportunities.

### What is the role of the cloud in finance?

Cloud computing provides solutions enabling companies to reduce costs, improve their service performance and respond with speed to changes in business. In a rapidly evolving environment such as the financial landscape, where customers are ever more demanding and the competition increasingly tight, being able to handle technology and data strategically is a vital part in business survival and for creating value. The cloud is a crucial enabler of data valorization, especially in terms of increased computing capacity for use in and by other technologies, and it is also gaining ground as an instrument for storing and sharing data safely across this market.

### How is the cloud perceived in finance?

The cloud, mainly in its public and hybrid forms, is deemed to be the most relevant and beneficial technology for creating value from data sharing and the exchanging of such data. The main benefits associated to the cloud are to enhance business value, enable advanced services in the field of artificial intelligence (AI) and machine learning (ML) and optimize the costs of operations. Cloud technology adoption also presents a high-risk profile, mainly for the associated security, privacy and regulatory concerns.

### Do European financial institutions trust the cloud?

Cloud technology is used widely by European FIs for data valorization, and the pandemic-related crisis has escalated its adoption. Within organizations, demand for the cloud can often be driven by needs in business units or by the IT department, but, to be implemented effectively, this technology must be backed strategically by steady support from senior executives. Public and hybrid clouds are used to a large extent by companies for storing their and their customers' data, and European FIs are quite open to sharing sensitive and confidential data on the cloud. This openness would nevertheless be greater if data privacy were a cast-iron certainty.

### What about a cloud ecosystem?

European FIs are apparently also open to systemic initiatives to provide big data infrastructures and/or data exchange services based on the cloud, enabling data to be shared among the actors in the ecosystem. The main benefits expected from the ecosystem are the elaboration of analytics and the gaining of insights from shared data, and it also provides the means to explore new business models. These solutions also bring up a series of implications in terms of regulations and security-related issues. Perception of these ecosystemic solutions and their potential adoption rate can be improved if the promoter is a system-wide player.

# 1. Cloud Computing for Digital Innovation

## 1.1 The cloud journey in the financial industry

Cloud computing is a new way of using digital technologies, where its main feature is the transition from proprietary asset to a service. According to this model, companies can easily access a set of configurable resources via the internet, which are readily provided by their cloud service provider (CSP).

The cloud paradigm can radically change IT operations, making their architecture agile and paving the way for digital transformation and new business opportunities.

The typical path of adopting the cloud for a company involves leveraging on different cloud deployment models, particularly private and public clouds, in combination with on-premises systems, resulting in hybrid and multi cloud environments. Companies are thus given the tools to help them build a cloud ecosystem tailored to their economic, technical and functional needs.

This approach is particularly true in the financial sector, where IT is pervasive in all processes, entailing greater complexity in its maintenance and evolution, as well as in an eventual migration to the cloud. Moreover, regulations on data privacy tend to be stricter in the financial industry than in other sectors, and financial entities are subject to closer scrutiny by the competent authorities. These characteristics make hybrid and multi cloud environments the most common choice in this particular industry. A hybrid cloud ecosystem provides companies with the opportunity of using different deployment models, enabling them to use on-premises resources for storing privacy-sensitive data or applications, while exploiting the scalability and flexibility of public cloud platforms for other cost-effective and value-added solutions more able to exploit their data assets. A multi cloud ecosystem reduces the risk to companies of vendor lock-in, enabling them to select the service that fits them best from among those offered by each public cloud provider. For these reasons, financial companies usually resort to a combination of the two models and so exploit the advantages of both simultaneously.

Historically, concerns over data privacy, the geographical location of data, contract terms and the risk of provider lock-in have slowed down the use of public cloud platforms in the financial industry.

More recently, there has been an acceleration in the adoption strategies of financial companies. Generally, the adoption process starts from three types of application:

- Those that support employee productivity, such as collaborative work and emails, since these applications are standardized and there is a wealth of market leader solutions.
- New digital projects working on front-end applications that support relationships with clients, since the cloud is able to reduce the time-to-market while increasing accessibility, scalability and quality of the user experience.
- Innovative projects connected to artificial intelligence and advanced analytics, which require massive computing capacity and complex algorithms, thus resulting in a clear need for scalability that only cloud solutions can offer. For example, implementing machine learning algorithms in banking operations linked to anti-money laundering controls, where a vast volume of data must be analysed, could increase the company's ability to identify suspicious behaviour and provide a risk rate accordingly.

## 1.2 Cloud opportunities for data valorization

The paradigm of data valorization is gaining traction within companies, as the quantity of data generated and the opportunities to exploit them are increasing day by day. The burgeoning amount of available data can now be leveraged on as a strategic asset, allowing businesses to turn scattered information into valuable insights for the company.

This transformation is equally enabled by the spread of other digital trends connected to data exploitation, such as artificial intelligence and machine learning. The opportunities ensuing from the cloud computing stack for these purposes have become clear and attractive across all industries, including banking and financial services.

The adoption of public cloud platforms may introduce numerous benefits in those companies interested in gaining value from their data. Public clouds can lead to:

- Rapid access to ready-to-use state-of-the-art technologies.
- Delegation of technical skills and operational responsibilities to the provider, allowing the company to focus on its business needs.
- Affordable costs in terms of trying out new solutions, shifting these costs from capital expenditure to scalable operating costs.
- Competitive time-to-market.
- Agility to trial out big data analytics projects due to the public cloud's scalability and flexible pricing model.
- Potentially infinite computing capacity needed to manage large volumes of data.

There are several public cloud delivery models for companies to exploit when building their own data strategy, principally Infrastructure as a Service (IaaS), Platform as a Service (PaaS) and Software as a Service (SaaS). Each company can select the most appropriate delivery model according to its needs for speed of adoption/migration, customization and perceived risk of vendor lock-in.

The Platform as a Service option generates the most powerful opportunities for data valorization, since it can be used to build customized analytics software by utilizing tools designed to manage large volumes of data of different formats, using structured and unstructured databases, integrate data from different sources and exploit the provider's AI software components, all in view of accelerating the application development for innovative business uses.

Moreover, data valorization carried out through artificial intelligence systems is making the cloud an essential enabling factor. For example, in the banking sector, faster and more accurate machine learning algorithms applied to fraud detection operations is growing steadily, as identifying suspect transactions is increasingly becoming a top priority for players in the industry. Similarly, introducing conversational AI for handling requests and providing customized suggestions may enhance the users' experience, while other machine learning applications used in the underwriting process in credit scoring could improve the efficiency of the overall lending process. Financial institutions, in particular, could use AI-driven forecasts to help them predict stock market trends and fluctuations.

## 1.3 Challenges and solutions for adopting cloud data platforms in the financial industry

Despite the many opportunities offered by cloud technologies, financial companies still seem to struggle when it comes to adopting the cloud.

The concerns stem especially from the need to comply with the strict industry-specific regulations on data security and data privacy. Given the sensitive nature of the information that financial institutions handle, shielding data from unauthorized access and misuse is a key factor. Failure to comply with such regulations may result in hefty fines for the financial subjects involved and reputational damage in the eventuality of data breaches.

Moreover, moving to the cloud could be associated with a perceived loss of governance over core data and applications, which may prevent the financial companies' ability to have sufficient control over the resources migrated to the cloud.

Another widespread challenge is the risk of vendor lock-in, which may determine loss of competitive pricing of services on the company's side and a greater dependency on the technology vendor once the migration towards a specific cloud provider is completed. This contingency is a major challenge in all industries, but is particularly critical in the financial market, in that it is subject to regulations setting out the requisite and enforceable outsourcing criteria, some of which apply specifically to cloud-linked choices.

Lastly, for the cloud to be introduced successfully in financial companies, a prerequisite is organization-wide transformation. Financial companies, which usually rely heavily on legacy applications, can only truly reap the benefits of cloud technologies if they adapt and optimize their applications for use in the cloud: this translates into acquiring technology-specific competences, extensively re-thinking their IT processes and creating new dedicated roles within the organization.

The development of a data ecosystem for financial entities, which leverages on cloud services, would enable data to be shared securely among financial companies, enabling them to extract the highest possible value from information assets, for instance through the implementation of artificial intelligence projects, whilst complying with industry regulations and reducing dependency on a single cloud service provider.

However, to fully grasp the benefits offered by a common data ecosystem exploiting the cloud, it is crucial to develop standards and design policies to manage sensitive data while ensuring privacy and interoperability.

## 2. Drivers of Innovation in the Financial Services Market

### 2.1 Cloud technology as a driver of the customer satisfaction

#### 2.1.1 Improving the customer experience

Recent developments in financial services show the clear pressure on traditional players in the direction of innovation. This trend is partly driven by new customer desires and needs. Over the years, all types of customers have built up their expectations in financial institutions, counting on them to match the user experience they find in e-commerce, social networks and other high-tech settings. Financial players are progressively developing e-banking solutions as the means to meet changing demand and satisfy their customers in an efficient way, and this calls for the introduction of innovative digital technologies.

Demand by customers (especially retail customers and SMEs) is changing and becoming increasingly more challenging for financial institutions to satisfy. When asked to imagine their bank or insurance company in the future, consumers tend to highlight needs relating to an improved customer experience.<sup>1</sup> Today's primary requirements also include speed in executing the various operations and responding to problems, greater transparency in the investment of their savings, increased opening hours and flexible availability, ideally 24/7, together with the option of doing everything from a smartphone.

Customer satisfaction is a core element in how banks and insurance companies can create and retain their competitive advantage. As specified in the next sections, the implementation of services based on cloud computing is one of the key factors driving efficiency, security and customer satisfaction within e-banking services, signalling the strategic relevance of bringing cloud technology into play.

#### 2.1.2 The role of data

In order to be effective and efficient in delivering innovative services coherently with their customers' expectations, financial institutions must make significant investments in the data valorization field. As in any topic involving innovation, data are at the core of the discussion. Both availability and an appropriate leveraging of data are essential for getting to know one's customers and meeting their needs, in terms of both user experience and financial objectives.

On the one side, consumers are increasingly willing to share information with their bank or insurance company, although this depends to a large extent on the type of information they are required to share. Consumers are by and large disposed towards disclosing financial data to their bank or insurance company as long as it is data about their investments, online and offline purchases, or travels and movements. They are more wary about sharing data relating to their activity on online social networks.<sup>1</sup> Clearly, when addressing the matter of sharing one's data, which is an important part of data valorization, the security of the financial system in question becomes crucial in building credibility and drive such data sharing practices. Moreover, consumers tend to be more willing to share their data when they could gain additional value in return, which could be the pricing of services or service customization.

On the other side, linked to the implications of data valorization, there is clearly the need for a discussion on how financial institutions, in both banking and insurance, are strategically introducing technologies in this

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<sup>1</sup> For more details, please refer to the [Fintech & Insurtech Observatory, Politecnico di Milano](#).

field. The risks and benefits of the various technologies applied to data collecting, data sharing and analytics differ, and they also entail a trade-off concerning what the company, market, regulators and customers all need. In particular, the academic world and practitioners alike are stressing the relevance of the cloud as a crucial enabler of data valorization, especially in terms of its computing capacity for other technologies, but increasingly also as an instrument to store and share data safely across the financial market.

Compared to other technologies, the cloud has a huge potential for data sharing, but before implementing a cloud service, companies need to consider carefully all the risks and benefits, to create customer trust and guide the choices of regulators and company executives.

## 2.2 Cloud technology as a competitive tool

Alongside the evolution in customer expectations, financial players are also facing an evolving competitive environment. Digital transformation is reshaping the configuration of financial industry supply chains in a number of ways. On the one side, new competitors with innovative and fully digital business models are entering the competitive arena. On the other, established players arriving on the digital technology scene - even those not historically related to finance - exert pressure to lower costs and improve efficiency, so as to keep up with the competition.

For instance, international Fintech & Insurtech startups are the visible expression of a thriving ecosystem, one able to offer innovative services to the entire economic system, with some interesting features emerging in Europe. Out of all the post-2015 startups that have raised at least 1 million US\$, Europe was the breeding ground for 768 Fintech & Insurtech startups. Most startups are turning to the world of banking services (63%), followed by those of investment (32%) and insurance (15%), some operating in more than one field. As many as 43% of all startups offer technologies designed for the financial and insurance industry, often providing them alongside, or even packaged with, banking or insurance services. Another 19% are RegTech startups, which operate in the world of regulation.

Fintech and Insurtech startups have two main features: their innovation in the adoption of technologies to carry out their work, and their openness to cooperation and exchanges with other companies, not necessarily within the financial industry.

Collaboration is closely associated with the concepts of open data ecosystems, and more precisely open finance and open banking. Under the PSD2 regulation, banks are, in practice, required by the regulator to open their APIs up and share, as long as they have been given prior consent, their customers' data with third parties. Fintech and Insurtech startups can exploit the opportunity provided by APIs to gain access a huge amount of data and leverage on their technological capabilities to deliver unique value to their customers. European Fintech and Insurtech startups are basing their model on open architecture, and are thus open to partnerships with other players. As many as 71% are at least in one partnership. Among the main assets that companies recognize in startups and which induce them to enter into collaborations, are technological capabilities.

Within startups, cloud computing is a top trending technology, with its interesting opportunities in terms of scalability and flexibility, as well as its potential for sharing data. Worldwide, 23% of all startups already use cloud computing, and 19% in Europe.

But it is not only startups. Globally, hundreds of non-financial firms - in sectors as varied as automotive, utilities, retail and telecommunications - are developing financial services not strictly related to their core business. The PSD2 regulation also hastened the opening and establishing of interactions between banks and these external players. The offer from these players is greatly gaining in importance, as they base their financial services proposal on assets relevant to the future of finance (user base, customer engagement, financial resources, etc.)



The discussion so far shows that innovative players may pose some threat to the sustainability of traditional business models, the very same models that many established companies have relied on for years. In fact, customers are showing a growing openness to consider alternative financial service providers. The entry of new players, however, also offers opportunities for collaborations intended to generate value for customers. Banks and insurance companies can choose whether to set up and embrace the new ecosystem, leveraging on the benefits of new technologies, or else they risk losing opportunities or may even become excluded from entire market areas.

In parallel, the adoption of digital technologies enables companies to operate in a more efficient and flexible way. Researchers show that firms which do not implement such technologies in an effective way risk suffering from a competitive disadvantage in terms of costs.

The many benefits brought about by cloud computing make this field a natural candidate for addressing the challenges and opportunities now faced by financial institutions. Cloud computing can provide solutions whereby companies can reduce costs, improve their services and respond quickly to business changes. In a rapidly evolving environment, with ever more demanding customers and increasingly tight competition from both established and innovative players, being able to deal strategically with technology seems to be a vital component to survive and create value.

### 3. Cloud Adoption in European Financial Markets

Considering the evolving landscape in financial services, an effective data valorization strategy is becoming of major importance to financial institutions, with the potential of helping them deal effectively with the increased competition in the offer side, while delivering an improved experience for customers and thus bringing benefits to the whole financial system. As described in Section 1, among the various technologies, the cloud is clearly an essential enabling factor in any such strategy.

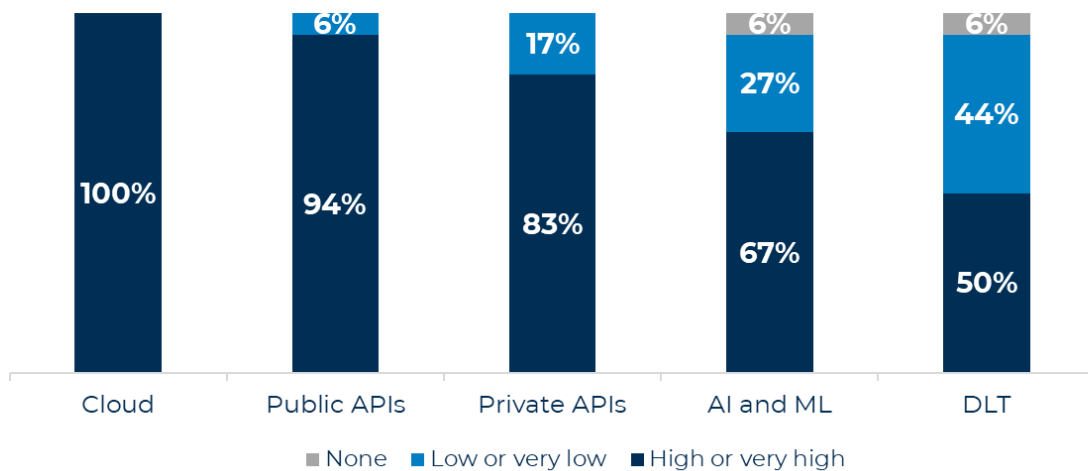
Alongside the benefits of cloud technology in deploying internal applications for data valorization - such as rapid provision, business agility and scalability - the cloud is also acquiring a crucial role within data centric computational workload, and data sharing and exchanging. Because, thanks to the cloud, they can access data from different sources and actors, financial companies can extract the highest possible value from their information assets.

Clearly, the question of security, privacy, regulations and data governance means that any cloud adoption undertaking is not straightforward, especially when sensitive data is involved. Furthermore, these concerns may call for the introduction of systemic initiatives, to be enacted by trusted actors on the market, which would be able to create real data ecosystems for financial entities. While leveraging on cloud services, these initiatives could address most concerns, e.g. come with the guarantee of complying with the industry regulations, reduce dependency on a single cloud service provider and provide system-wide safeguards on data security.

As a result, there is no clear situation as to the positioning of financial institutions (FIs) across Europe and in the different market segments for this technology, particularly in terms of the risks and benefits linked to data centric processing and data sharing. In order to assess where the market stands on these issues, the research team interviewed 18 senior executives expert in the sector of IT technology from 15 leading financial services companies across Europe<sup>2</sup>.

#### 3.1 Technologies for sharing and exchanging data

Figure 1: **Relevance for sharing and exchanging data**



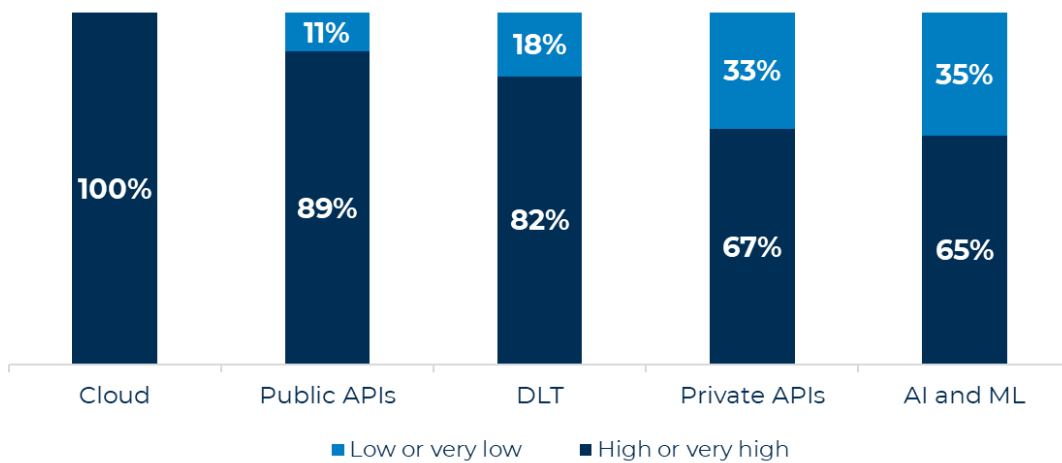
<sup>2</sup> See the section on Methodology for additional details

The cloud is deemed to be highly relevant in data sharing and exchange, holding a higher approval rate on the market than either established technologies like APIs and emerging technologies like DLT.

Experts across the market clearly recognize the role of the cloud as a key enabler for data sharing, even when compared to other technologies. The cloud is the most significant enabler, with experts indicating that this technology has a high or very high relevance for data sharing and exchange in 100% of the cases.

The cloud has a slight edge over one technology traditionally associated with data sharing, API, whether public or private. So, while 94% of the respondents indicated that public APIs are highly or very highly relevant in data sharing and exchanging, and around 83% for private APIs, it also emerged that the cloud is seen to have an advantage over DLT, AI and ML as the prime channel for sharing and exchanging data.

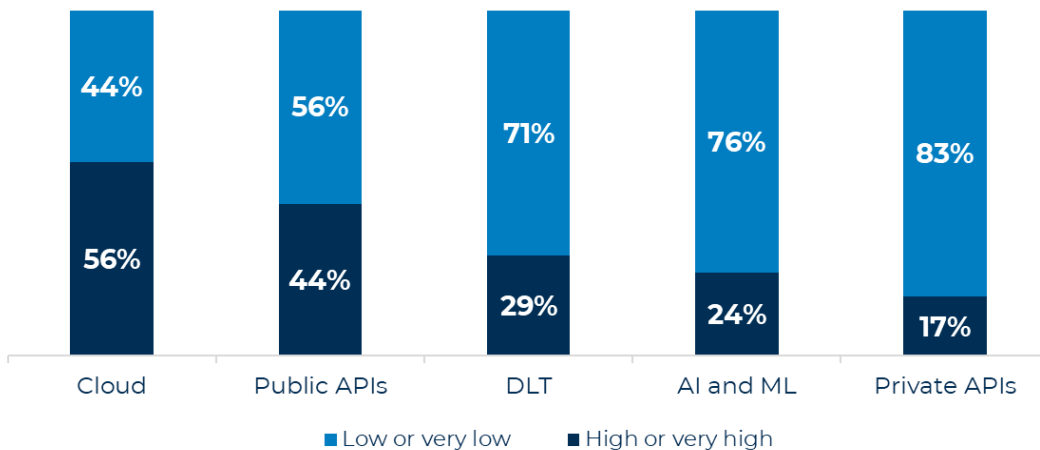
Figure 2: **Benefits in sharing and exchanging data**



The cloud also shows important benefits in data sharing, overriding all the other technologies.

There is a strong consensus about the size of the benefits derived from sharing and exchanging data through the cloud, as 100% of the respondents felt that leveraging on the cloud for these purposes produces high or very high benefits. The perceived benefits deriving from sharing and exchanging data through the other technologies are, instead, on average lower and more unclear. This is particularly true for DLT, AI and ML, as some experts do not see any benefits of utilizing them in this field.

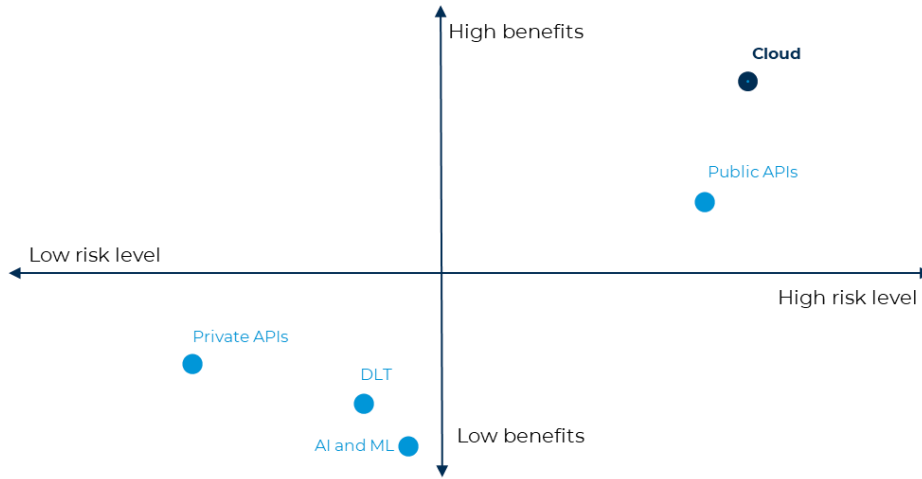
Figure 3: **Risks in sharing and exchanging data**



While delivering benefits, the risks linked to data sharing on the cloud are higher than other technologies in this domain.

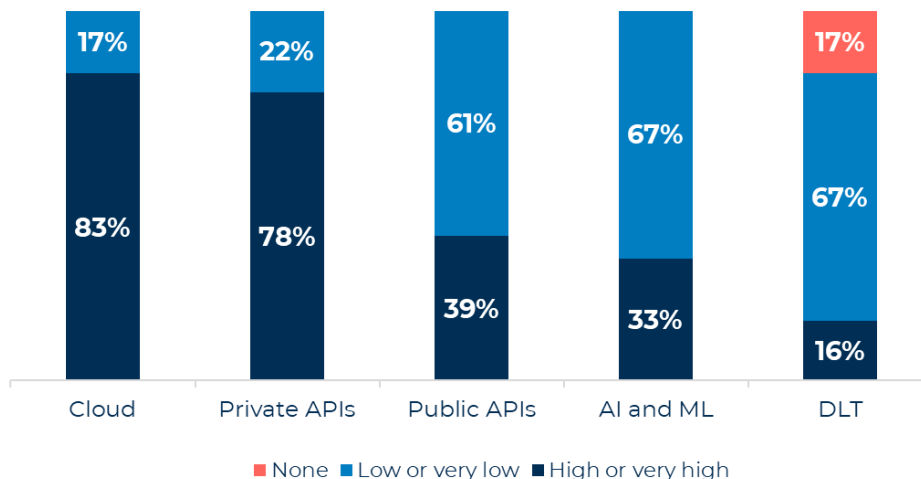
On average, comparing the perception of benefits against risks, the market has a positive view of all the technologies involved in the domain of data sharing, whether they are clear enablers, such as the cloud and APIs, or technologies more involved in data valorization, such as AI and ML. Higher benefits are associated with higher risks on average. Of the senior executives interviewed, 56% associated a high or very high level of risk to sharing and exchanging data on the cloud. This number is lower in other technologies (44% for public APIs, 17% for private APIs, 29% for DLT and 24% for AI plus ML). Interestingly, the perceived risk level for public APIs is similar to that of the cloud, suggesting that opening up databases to other actors may be the key driver in generating risks while, in parallel with the unclear nature of the benefits, the risk level associated with DLT, AI and ML is very volatile and variable across the sample.

Figure 4: Risks-benefits matrix from a data sharing perspective



Overall, the cloud and public APIs present a high-benefits high-risks profile for data sharing, with the cloud narrowly above public APIs in both aspects. Predictably, private APIs appear to be less risky and less beneficial than the cloud and public APIs in this field. DLT, AI and ML are question marks, with no clear risks-benefits profile.

Figure 5: Inclusion in company budget

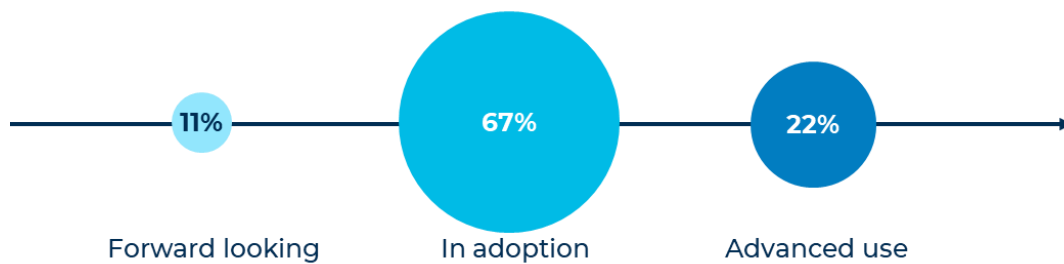


Data and Innovation senior experts see the cloud as being allocated most funds among all mentioned innovative technologies, underscoring the strategic importance of cloud computing within financial institutions across Europe.

Previous considerations regarding the importance of the cloud are reflected in the amount of budget being allocated for next year in the various organizations. On average, most experts across the market see the cloud as having a high or very high share of the budget allocation, followed by private APIs, while public APIs, DLT, AI and ML tend to lag behind. The unclear assessment of the risks and benefits associated with the introduction of DLT, in parallel with the low amount of money allocated to it in the organizations' budgets, may signal the unexplored potential of DLT technology in data sharing. On the contrary, the fact that AI and ML have been implemented on a wider scale in organizations, despite the low level of associated benefits, could indicate that AI and ML may express their potential in other fields, such as applications for *pure* data valorization. The cloud, instead, seems to be a better-known technology with high potential in data sharing. Experts deem it critical for both the performance of an organization and the risks that it may face. So far, the discussion highlights that experts across the financial services industry are considering cloud computing as a strategic and critical technology for data storing and sharing.

### 3.2 Public and hybrid clouds for data valorization

Figure 6: **Current state of public or hybrid cloud adoption for data analytics**



Together with the relevance of the cloud in data sharing and exchange discussed above, this technology can also be applied to other stages of the data valorization value chain, such as data analytics.

Data show the widespread implementation of public or hybrid clouds in infrastructures, platforms and applications for data analytics in the sampled organizations (89%).

In all cases, the senior executives interviewed for the survey reported that their companies have at least planned to use public or hybrid cloud services for data analytics. A small share (11%) declared to be in a forward-looking stage, either planning to use the cloud within twelve months or are/will be drafting an implementation strategy, possibly working on proofs of concept (PoCs). Nearly 90% said they are currently making use of the cloud, either in a ramping-up phase (two-thirds of the sample) or in advanced mode (22%).

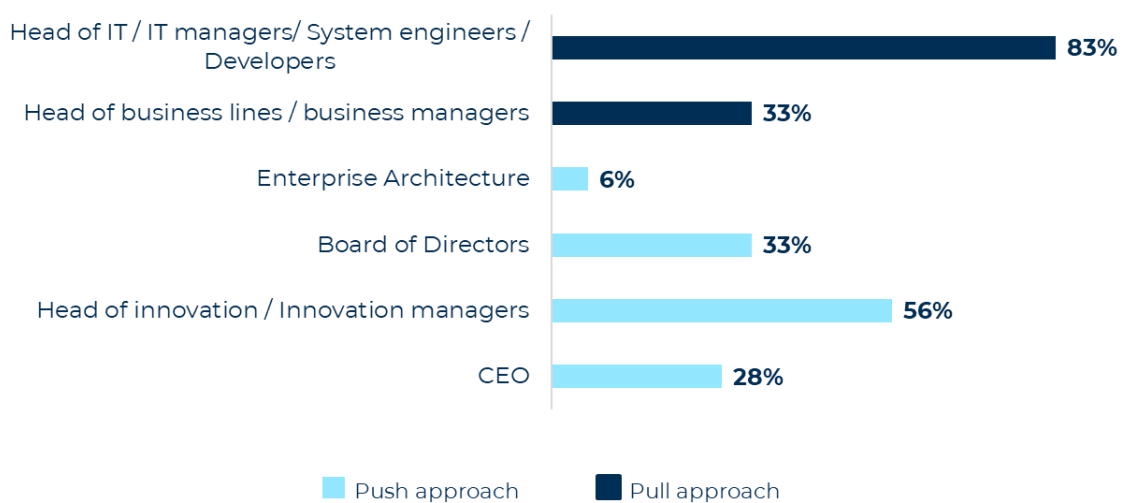
Figure 7: **Impact of the Covid-19 pandemic on public or hybrid cloud adoption**



Interestingly, there was no negative impact of the Covid-19 emergency on planned or actual cloud implementation. In 44% of cases, the Covid-19 pandemic propelled forward the status of public and hybrid clouds in their organizations, in all cases accelerating an ongoing situation.

This result suggests that the strategic adoption of the cloud may be driven more by dynamics internal to the organization and by the maturity of the technology itself, than by external shocks as the Covid-19 pandemic. However, exogenous factors like this may accelerate the adoption in well-prepared organizations.

Figure 8: **Main promoters of cloud adoption within the organizations**



As to be expected, the people most actively engaged in pushing for the adoption of public or hybrid clouds work in the IT department (83% of the cases) and in innovation (56%). However, in 33% of the cases, the heads of the various business lines and the business managers are reported to be amongst the primary agents of change.

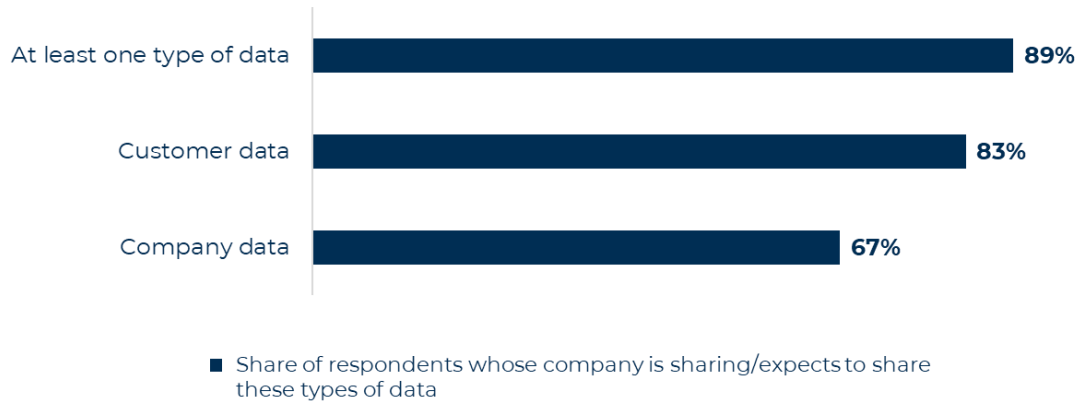
This suggests that the demand for cloud solutions can often arise from business needs.

In general, two approaches to cloud adoption seem to emerge. The first is the “push approach”, driven by the Board of Directors, the CEO or the innovation area. The second is the “pull” approach, where business lines or the internal technological departments are the ones “pulling” the process. The method seems to be a purely “push” approach in 17% of cases, a purely “pull” approach in another 17%, and is a mixed approach in the remaining 66% of cases, where both sides, the strategic bodies on their part, and the business lines and IT departments on theirs, are actively engaged in promoting the cloud adoption. Of the organizations that declared to be at an advanced stage in the adoption of cloud technology, 75% reported that the CEO is

the reference point for this kind of innovation, while this holds true only in 7% of the organizations with less advanced cloud strategies, suggesting that the cloud seems to need the strategic support of senior executives to be introduced effectively in complex organizations like the companies in the sample.

### 3.2.1 Data on public and hybrid clouds

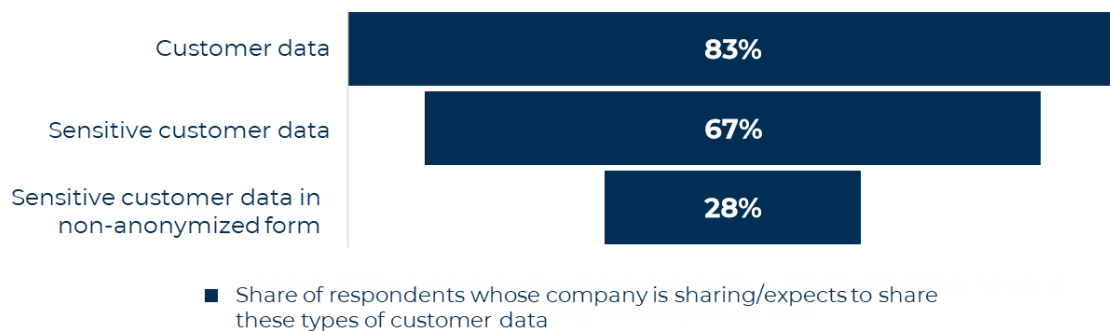
Figure 9: **Types of data on public or hybrid clouds**



Considering the types of data that the companies have been sharing, or expect to share, on public or hybrid clouds, most respondents in the sample appear to be ready to include customer and/or company data.

Overall, 89% of the senior executives pointed out that their company is placing or about to place data on public or hybrid cloud platforms. It seems that financial players are more inclined to transfer information relating to their customers onto public or hybrid clouds (83% of the survey respondents), rather than their own company information (67%).

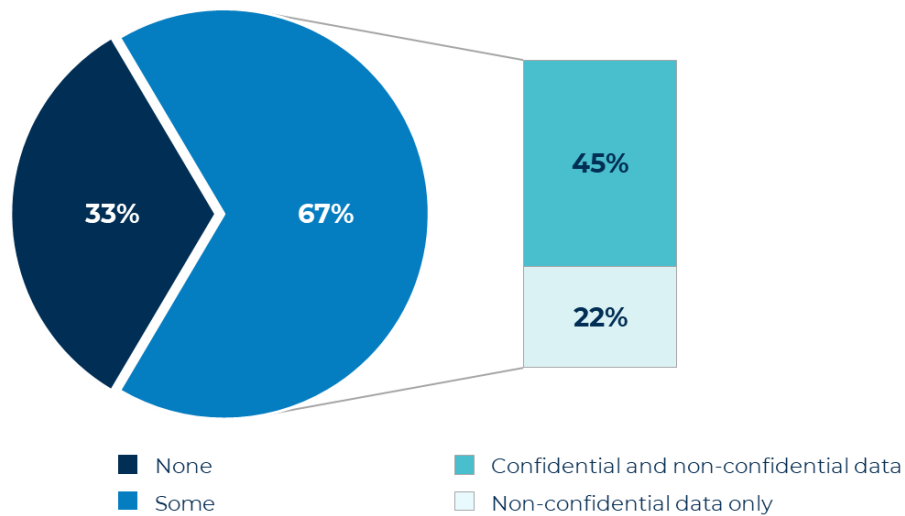
Figure 10: **Customer data on the cloud**



Despite some variability across the companies, it seems that placing sensitive and confidential data on the cloud is critical for only a small share of the sample.

Looking at the customers' data, a good 67% of the respondents are comfortable with transferring sensitive data (such as personally identifiable information - or PII) to the cloud, while only 16% are ready to share strictly non-sensitive information relating to their clients. Exploring this topic further, in 28% of cases (that is, the 42% of those willing to share their customers' sensitive data), the survey respondents declared that their firm is ready to share their customers' sensitive data even in a non-anonymized form, while 39% of the respondents stated that their company is inclined to place PII on the cloud only in anonymized or hashed form.

Figure 11: Company data on the cloud



For company data, instead, 45% of the respondents reported that their organizations are using or are about to use the cloud as a repository for confidential company data. This figure corresponds to the 67% of those that declared to be ready to transfer company data to the cloud.

Within the sample analysed, a subgroup of 22% of the senior executives is open to use the cloud to store confidential/sensitive company and customer data in a non-anonymized form.

On the contrary, another 22% declared that they would use cloud technology to store only non-sensitive and non-confidential data, and 11% of the experts noted that their organizations are basically unwilling to utilize the cloud for data-storage purposes.

Overall, despite some variability across the companies, it seems that placing sensitive and confidential data on the cloud is critical for only a small share of the sample, revealing an interesting vote of confidence in the security of the technology. However, it is apparent that the cloud provider must put in place adequate levels of protection to safeguard the data from leakages and damage. As a matter of fact, a significant 39% of the experts interviewed predicted that they would be more inclined to share sensitive customer data in a non-anonymized form on the cloud should the provider ensure that stricter privacy controls are in place.

### 3.2.2 Barriers and benefits for cloud adoption

The data highlight the significance and distribution of cloud computing, along with a general positive tendency to uploading sensitive data on public and hybrid cloud platforms. A series of barriers and risks linked to leveraging on public and hybrid clouds for data analytics reasons, as well as the potential benefits, need however to be assessed in order to guide decision making both in companies and by the relevant authorities.

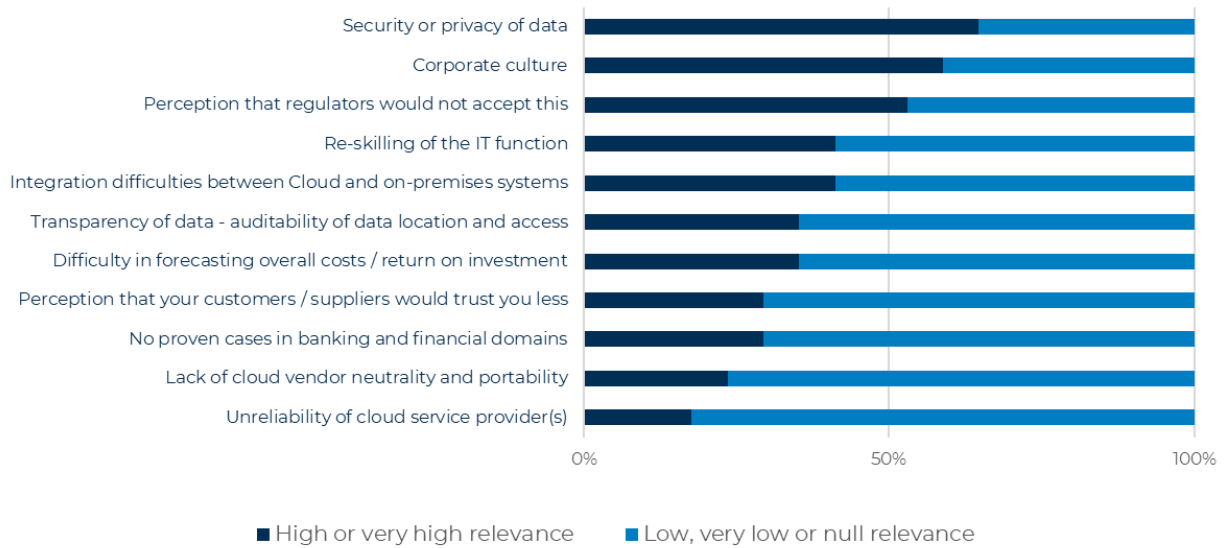
The difficulty of protecting security and privacy of data appears to be a crucial barrier to adopting public and hybrid clouds for almost two thirds of the experts, recognizing the fears and needs of customers.

Looking at the barriers to the adoption of public or hybrid cloud technology, the most relevant is the security and privacy of shared data, with 65% of the survey respondents indicating it as a high or very high barrier. Next in line is corporate culture (59% ranked it as high or very high in relevance), followed by the risk that regulators would not accept such a solution (high or very high relevance for 53%). All the same, a small group of respondents (6% for privacy concerns, 11% for corporate culture and regulatory concerns) scored these factors as low in relevance, indicating a certain disagreement in the market. By contrast, the unreliability of the cloud service provider was a major barrier for only 20% of the sample, and the lack of cloud vendor



neutrality and portability was so for only 24%, while only 31% saw the lack of proven cases in the banking and financial domains as a major obstacle to cloud adoption.

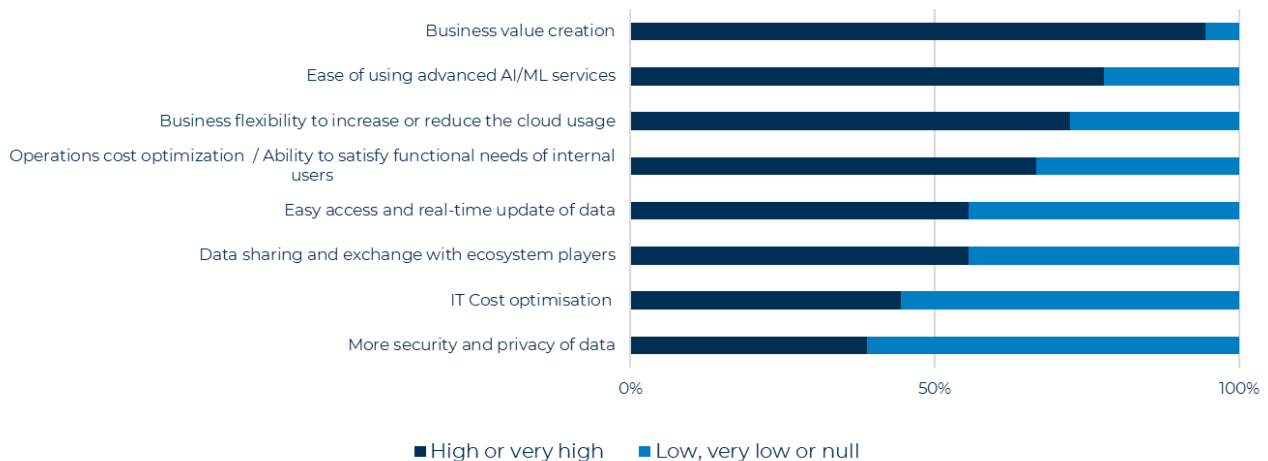
Figure 12: **Barriers to the adoption of public and hybrid clouds**



To sum up, it seems that the market of cloud solutions is quite mature, known and reliable; however:

- a) Cloud providers need to work further and demonstrate their cloud credentials to allay concerns about privacy.
- b) Company executives may try to instil a corporate culture that is more accepting of and proactive in engaging with the cloud.
- c) The regulators should focus on clarifying the regulatory framework.

Figure 13: **Perceived benefits from the adoption of public or hybrid clouds**



Virtually all experts recognize the potential of cloud computing, especially in public or hybrid settings, for creating more value for businesses and customers and as an enabler of other advanced technologies.

Regarding the perceived benefits that the experts expect from utilising public and/or hybrid cloud technology, there is strong consensus in its possibility of creating business value (improving a company's agility in launching new products and services and better satisfy the functional needs of their customers).

With 94% of the respondents indicating this factor as a highly or very highly relevant benefit, business value creation shows the potential of the cloud for introducing innovative customer-centric solutions in FIs, evolving and improving the traditional FI business model. This may be crucial for their readiness to compete with new cloud-native players in the industry.

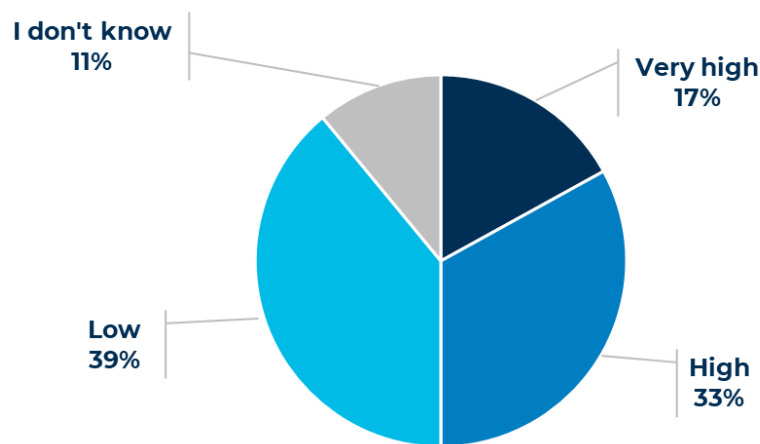
After business value creation, another major benefit deriving from adopting cloud technology seems to be the ease of use concerning advanced AI/ML services (with 78% of answers that classify this as highly or very highly relevant). This is interesting as it confirms the crucial role played by the cloud as an enabler for other advanced technologies. Business flexibility (due to the scalable nature of the cloud) is highly or very highly relevant for the 72% of the sample, as is, for 67% of the respondents, operation costs optimization (e.g. efficiency for the workforce) and the ability to satisfy the functional needs of internal users.

Interestingly, IT cost optimization is perceived as a major benefit by only 44% of the respondents. On the basis of this analysis, it can be concluded that the adoption of the cloud in FIs is more oriented towards effectiveness of the processes and the creation of value than the efficiency and internal optimization of the processes.

As a final remark, confirming the discussion on privacy concerns relating to the cloud, it emerged that the least relevant benefit expected from cloud adoption is the improvement of data security and privacy (for 59%, this is of low or very low relevance).

### 3.3 Data ecosystems based on the cloud

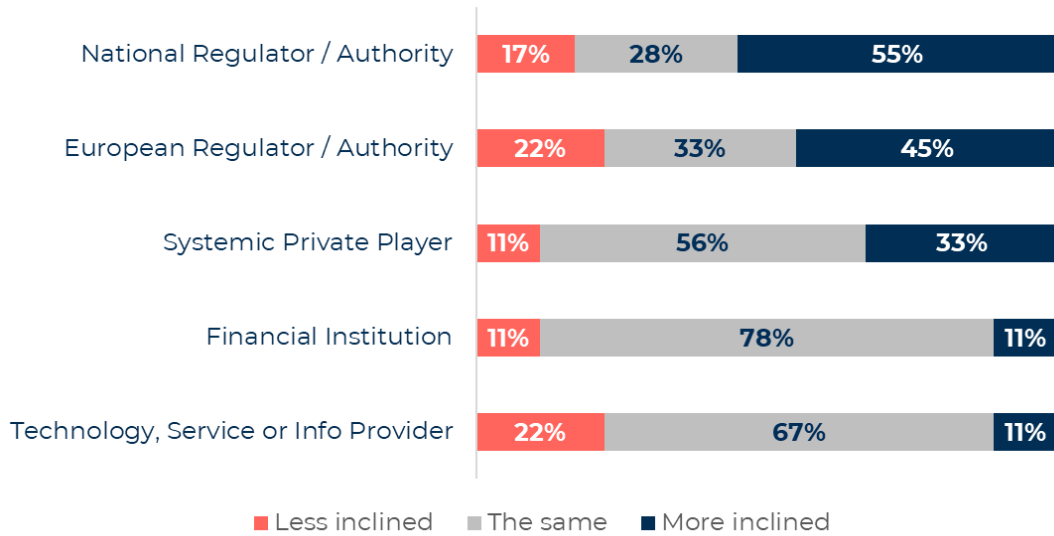
Figure 14: **Inclination to use a big data infrastructure or data exchange services based on the cloud**



Half the senior executives are positively disposed towards systemic initiatives for building big data infrastructure or data exchange services based on the cloud to enable the exchange of data among different actors in the ecosystem.

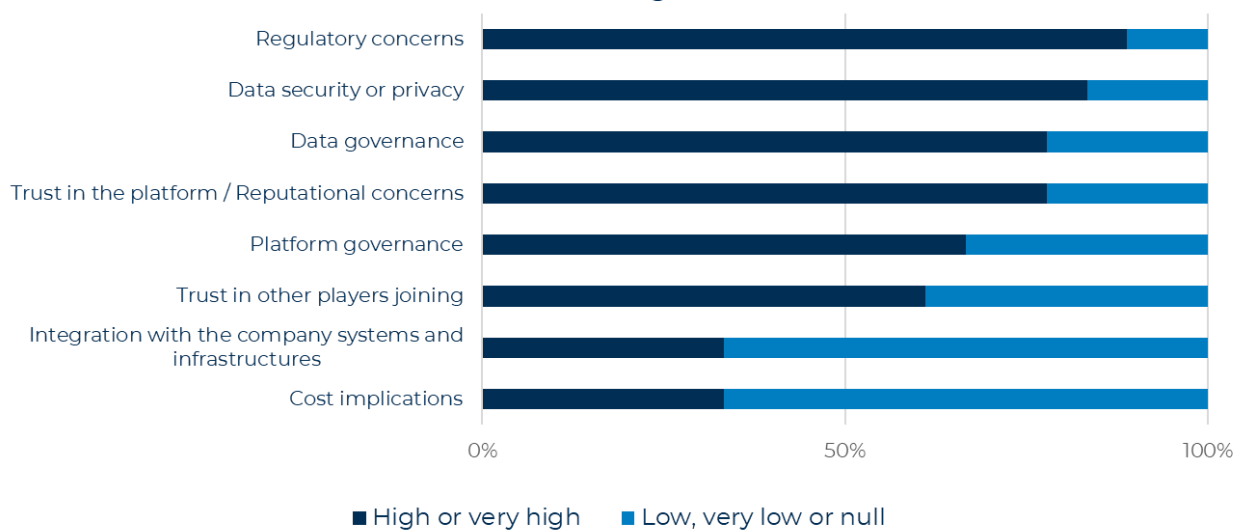
Cloud technology can be a powerful enabler for exchanging data among different players in the financial industry. On this basis, the actors can create an integrated ecosystem of financial services. Even if the discussion about projects relating to this kind of cloud application is still open, at least half of the experts declared that their organization would be eager to exploit the opportunities to be derived from the cloud. Nevertheless, 39% of the respondents claimed that their organization still has a low inclination to use the cloud from an ecosystem perspective.

Figure 15: **Whether companies would be inclined to use a big data infrastructure should the provider be a:**



However, a predisposition towards cloud technology would improve significantly if the provider of the infrastructure underpinning the ecosystem was a regulator, a European authority or a “systemic” private player (such as a stock exchange). A majority of experts (55%) believed that their company would be more willing to join such an infrastructure if it were run by a national authority (such as a regulatory body), slightly less than half (45%), if it were run by a European authority, and one third if it were a private player of a “systemic” type. This is not the case if the provider was a financial institution - such as a commercial bank or an insurance company - or a technology provider. In the first case, a company’s inclination to use the cloud would not change, on average, while in the third, technology provider, case it would, on average, even decrease slightly.

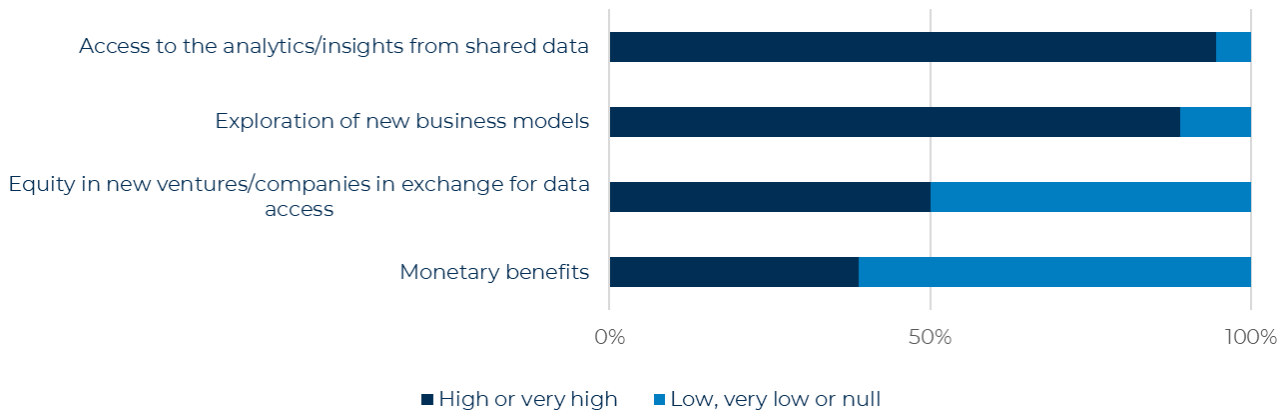
Figure 16: **Concerns related to the cloud-based infrastructure for data exchange**



The main concerns are once again of a regulatory and security-related nature, while the possibility of exploring new business models and leveraging shared data represent the main benefits.

Despite a general positivity towards the potential of such ecosystem-wide initiatives, the barriers are, on average, even more substantial than for the adoption of public and hybrid cloud technology within an organization. Again, the two main concerns appear to be data security and data privacy (83% classify this as a highly or very highly relevant concern) and regulatory concerns (89% put this as of high or very high relevance). Two other main barriers are concerns relating to data governance and reputational concerns linked to trust in the infrastructure provider (with 78% of the answers classifying them as highly or very highly relevant concerns in both cases).

Figure 17: **Expected benefits from cloud-based infrastructure for data exchange**



Higher concerns are still associated to higher benefits. The primary benefits deriving from an ecosystem-based cloud are, for the entities interviewed, the exploration of new business models (high or very high relevance for 94%) and the access to insights from shared data (100%), while it seems that the possibility of creating joint ventures and equity partnerships is less relevant (high or very high relevance for 53%). No strong consensus regarding monetary benefits has been reached so far, with high variability across the sample regarding the relevance of this topic, and 56% of the sample reported that this type of benefit has a low or very low relevance in their organization.

Overall, the creation of an infrastructure for processing, storing and sharing data based on cloud technology seems very interesting for the majority of senior executives involved in the survey. The adoption of cloud technology can generate substantial benefits in terms of data analytics and new business models. But there are still concerns relating to the safety of such an infrastructure, especially in the domain of data security, reputational risk and regulatory concerns. If the promoter of this type of infrastructure were a “systemic player” (such as a regulator or a stock exchange), it could improve the perception and adoption rate of cloud technology.

## 4. Conclusion and Way Forward

The cloud can provide a new competitive advantage to financial institutions (FIs), while improving the customers' experience and satisfaction. The need for speed, transparency and flexibility in interactions with FIs via digital solutions are just some of the features demanded by customers. Cost optimization, service performance improvements and the rapid response to business changes are further cloud-related benefits to be exploited by FIs facing an evolving competitive environment, with innovative and fully digital competitors entering the market and the pressure on efficiency, as a consequence of established players bringing in digital technologies. It thus could become a vital component in the survival of FIs and their creation of value.

Cloud computing is strategic for implementing data valorization strategies, as it gives companies access to potentially infinite computing capacity for managing large volumes of data, whilst underpinning other technologies, such as artificial intelligence (AI) and machine learning (ML), and providing the means to undertake big data analytics projects, because of its features of scalability and flexible pricing model. In data sharing and exchange, which are pivotal in data valorization, the cloud is perceived to be more relevant than other technologies such as APIs, DLT, AI and ML. Cloud computing is also associated with the highest level of perceived benefits and the highest level of inclusion in the organizations' expenditure budgets. Concerns about data security and privacy on the cloud, however, need to be allayed.

Our research shows that public and/or hybrid clouds appear to be widely adopted by European FIs in their infrastructures, platforms and applications for data analytics. Demand for the cloud often arises from business needs in companies. However, for the cloud to be implemented effectively in complex organizations, it requires the strategic support of senior executives. The level of adoption of such a strategic technology seems to depend more on internal dynamics and on the maturity of the technology itself than on external shocks, like the Covid-19 pandemic, which, nonetheless, accelerated cloud adoption in well-prepared organizations.

Public or hybrid clouds are generally trusted sufficiently to store company and customer data. It seems that FIs are quite open to sharing sensitive and confidential data on the cloud. However, this openness would be greater if stricter privacy controls were enacted.

While the market of cloud solutions seems quite mature, known and reliable, company executives, regulators and CSPs should act with the highest priority in the areas of privacy, corporate culture and regulatory framework to promote the introduction of cloud technology in the financial sector. These are the three main factors that may hinder the diffusion of public and hybrid clouds among FIs, preventing them from fully grasping the potential benefits with regard to creating business value, enhancing AI and ML services, business flexibility and increasing internal efficiency.

System-wide initiatives providing big data infrastructures or data exchange services based on the cloud may be the way forward to allow data to be exchanged among different actors in the ecosystem and in joint big data analytics projects. Such initiatives are perceived as highly beneficial in terms of access to analytics and insights from shared data and for exploring new business models, but several regulatory and security-related concerns still remain, re-igniting the need for the financial and public landscapes as a whole to work in synergy towards a common goal. Overall, the creation of such an infrastructure seems to be interesting for FIs, but its perception and potential adoption rate can be improved if the promoter is a regulator or another systemic player with deep connections to the financial sector in its entirety.

## Methodology

The objective of this research was to investigate how European financial institutions see cloud technology. Politecnico di Milano, with the support of Tata Consultancy Services (TCS) and Deutsche Börse AG, developed a survey that was submitted to senior managers expert in the field of technology at the most important European financial institutions.

The survey was designed to explore four different dimensions relating to cloud technology within FIs:

The perceived relevance, risks and benefits of cloud technology for sharing and exchanging data, compared to other technologies, such as application programming interfaces (APIs), distribution ledger technology (DLT), artificial intelligence (AI) and machine learning (ML).

The current state of adoption of the cloud (in the public and/or hybrid form) for data valorization, the main promoters of its adoption within companies and the impact of the pandemic on the adoption process.

The kind of data placed on the cloud, the types of benefits expected and the barriers to introducing the cloud.

The inclination for companies to use a cloud-based infrastructure for data sharing and exchange, its expected benefits and the main associated concerns.

A sample of 15 diverse European FIs was selected, operating in banking, finance and insurance. Eighteen experts were interviewed throughout the survey - all C-level executives in their companies' Departments of Technology, Enterprise Architecture, Cloud, Big Data and Analytics, Data Policy, Data Governance, Strategy and Innovation. The data reported in the figures derive from a quantitative elaboration of their answers.

The research and its contextualization within current financial and technological trends was also underpinned by expertise at Politecnico di Milano, which provided the baseline of a comprehensive literature review, several previous field studies on the topics under discussion and years of interaction with the main actors in financial and technology industries across Europe.

## Acknowledgments

The development of this research and whitepaper benefited substantially from the input of several actors from the industry.

We would like to render our sincere thanks to Deutsche Börse AG for their support and contribution in the survey development.

We would also like to extend deep gratitude to the eighteen experts who devoted their precious time to answering the survey and sharing their point of view.