



# ASSESSING THE REPORTED RISK FACTORS BY THE TOP CLOUD COMPUTING PROVIDERS

Garcia-Ortega, Beatriz <sup>a</sup>; Catala-Perez, Daniel <sup>b</sup>; De-Miguel Molina, Blanca <sup>c</sup> and De-Miguel-Molina, María <sup>d</sup>

<sup>a</sup>Universitat Politècnica de València, Spain ([beaqaror@doctor.upv.es](mailto:beaqaror@doctor.upv.es))

<sup>b</sup>Universitat Politècnica de València, Spain ([dacapre@ade.upv.es](mailto:dacapre@ade.upv.es))

<sup>c</sup>Universitat Politècnica de València, Spain ([bdmiqu@omp.upv.es](mailto:bdmiqu@omp.upv.es))

<sup>d</sup>Universitat Politècnica de València, Spain ([mademi@omp.upv.es](mailto:mademi@omp.upv.es))

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**ABSTRACT:** The literature has widely investigated the risks from the perspective of the companies adopting new and disruptive technologies. However, less attention has been paid from the side of the providers of such technologies. This paper aims to address this gap by assessing and initiating a discussion on the reported risk factors in the annual reports of five of the considered top providers of cloud computing services: Amazon, Google, IBM, Microsoft, and Alibaba, characterized by their avant-garde or disruptive technologies, their dependence on the internet and technological infrastructure, and their operation on a global scale. As main contributions, this research offers from the viewpoint of these companies a classification of the intrinsic risk factors related to their specific nature, grouped by subjects, along with the potential derived negative impacts on their businesses, and critically discusses some positive aspects and some potentially missing factors to be further addressed. Through this paper, we prepare the avenue for ongoing research including more companies and further assessment methods and criteria to further expand and enrich the findings.

**Keywords:** *Risk factors; cloud computing; annual reports; disruptive technologies; ethics.*

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## 1. PURPOSE OF THE PAPER

Under the umbrella of industry 4.0 and digital transformation, and as one of its main gears, cloud computing emerged a few years ago as an on-demand network access and

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service-centric model that delivers information technology resources such as infrastructure, components, and applications (Benlian et al., 2018).

Despite its inherent potential problems, risks, or challenges (i.e., privacy and security issues), cloud computing is taking off and growing vertiginously due to its multiple and substantial advantages and opportunities for companies adopting this service. Among its main contributions, cloud computing enables large-scale innovations for the benefit of its users and society (Benlian et al., 2018).

Moreover, in relation to the cloud computing risks, scholars have widely addressed such concerns and mitigation strategies from the perspective of the companies adopting this service (Alouffi et al., 2021). Nonetheless, to the best of our knowledge, little has been investigated in this respect from the side of the providers of this technology, which lean on new or avant-garde technologies, depend on the internet, and operate at a global scale. These providers shall also deal with their risks, which may affect their prospects and future performance. In this venue, as a starting point to fill this gap, this work aims to study the risks factors declared by the considered top five cloud provider companies worldwide, focusing on those more firm-specific, directly related to the very nature of these businesses. To this end, the authors examine their SEC Form 10-K annual corporate reports, section 1A, to assess and classify the potential risks these companies disclose and that could threaten their business operation, results, expansion, success, or even continuity.

As a main practical implication, the outcome offers a first approach to the main idiosyncratic risks or concerns declared by these companies at the technological avant-garde, which are in turn referent in their sector and beyond, as well as global main players, considering that those risks are highly significant for investors, governments, employees, banks, customers, users, and other relevant stakeholders. Likewise, this study points out certain missing aspects to be further considered as potential risks.

## 2. THEORETICAL BACKGROUND

### ***2.1 Cloud computing service model***

Cloud computing is one of the key ingredients in the puzzle of I4.0 and business digitization (Garcia-Ortega et al., 2021), and thus it is one of the main available new technologies for companies to adopt. As an on-demand network access model, and as a service-centric model, cloud computing is devised to provide information technology resources such as infrastructure, components, and applications (Benlian et al., 2018), and integrates artificial intelligence and machine learning capabilities (Kumar, 2016). Cloud

computing services can be private, public, or hybrid, a combination of the two, and may comprehend three main types of services: Infrastructure as a Service (IaaS), Platform as a Service (Paas), and Software as a Service (Saas) (CSA, 2009).

Through the cloud computing model, organizations, companies, or individuals as users may operate their data and applications on-demand from any device with an internet connection, at any time and from any place, as a measured service they pay for, thereby permitting transferring fixed costs to variable costs (Shimba, 2010). The adoption of this model provides potential benefits such as enhanced agility and flexibility, better efficiency, easier control of costs, scalability, and maintenance, and enables innovative services and business models which lead to large-scale innovations that ultimately benefit their users and society (Benlian et al., 2018).

### ***2.2 Risks for companies adopting new technologies***

According to Garcia-Ortega et al. (2021), the main potential difficulties or barriers identified by senior management of leading corporations when facing the adoption of new technologies are the lack of regulation, the code of conduct and ethical use, the security, the need to ensure specifically trained staff, the complexity and the high investments required, and the lack of top management support. In particular, the adoption of cloud computing involves a series of changes for a company, for example at the organizational level (Simba, 2010), and also a series of potential risks related to security, technology lock-in or licensing, monitoring, legal compliance, service level, performance, costs, governance, competencies, or industry structure (Bannerman, 2010). Dutta et al. (2013) classify those risks into four main categories: organizational, operational, technical, and legal risks. Some of these risks may be shared by companies providing this service.

### ***2.3 Risks for companies providing new technologies***

New and disruptive technologies involve risks not only for those companies adopting them but also for those acting as providers of such technologies. As proof of this, a number of leading companies in their industries dominating the market, with highly appraised top management, have failed and lost their privileged positions in front of other players when facing the situation of offering disruptive technologies (Christensen, 2013). According to Christensen, disruptive technologies usually target emerging markets that initially do not offer enough revenue for the growth expected in large companies, and there is also a risk of offering customers more than they actually need, require, or are willing to pay for; it is complicated to encompass the rate of offer and demand, and hard to justify investments that will not be sufficiently paid off at present or short-term.

However, as advanced in the introduction section, little attention has been paid by scholars to the intrinsic risks of the providers of new technologies and in particular cloud computing services.

### 3. DATA AND METHOD

The sample comprises the considered top five technological companies owning divisions that provide artificial intelligence and machine learning services through their cloud platforms, according to the Datamation portal (Maguire, 2022). These companies (and their cloud platforms) are respectively: Amazon (Amazon Web Services), Google (Google Cloud Platform), IBM (IBM Cloud), Microsoft (Microsoft Azure), and Alibaba (Alibaba Cloud). These companies are mainly characterized by their avant-garde or disruptive technologies, their dependence on the internet and technological infrastructure, and their operation on a global scale, being one of the leading and more scrutinized companies, not only in their sector but also worldwide.

Corporate annual reports are one of the most relevant sources of information about a company for investors, policymakers, and other stakeholders (Zhu et al., 2016; Huang & Li, 2011). In particular, Form 10-K is an annual report to be submitted to the Securities and Exchange Commission (SEC), compulsory for most U.S. publicly listed companies. Since 2005, the SEC mandates to include a specific section, Section 1A, comprising a discussion on the company's individual risk factors. In this section, which has an important and growing weight in the total extension of Form 10-K reports in the last years, the factors that make the company speculative or risky are reported in a sequential way by themes, with detailed explanations and examples reasoning them and their potential consequences. In fact, and especially after the financial crisis in 2008, the SEC has made more emphasis on the explanations and details about the specific risks they face (Campbell et al., 2014). According to Zhu et al. (2016), the companies' self-disclosed risk factors provide forward-looking information that may actually reveal the future risk of the companies and can be even used to predict potential stock change. In the same line, market participants consider risk factor disclosures for their firm risk assessment (Campbell et al., 2014). Furthermore, this disclosure, by warning investors of negative outcomes in advance, can also serve companies to protect against litigation risk, thereby acting as a 'litigation shield' (Skinner, 1994).

For each of the five companies selected, the Form 10-K annual reports published in 2021 were downloaded from the publicly available database *The Electronic Data Gathering, Analysis and Retrieval* (EDGAR), and the section Item 1A -Risk Factors- from each report was considered for the assessment. According to the SEC regulation, companies shall present and discuss in this section the most significant specific risk

factors for the firm, along with the specific adverse outcomes, in a logical and concise manner, leaving apart those that could apply to any issuer or any offering. In this sense, and in line with the SEC recommendations, we set the focus on those reported risk factors more inherent to the very nature of these businesses, above those risks that, although could also be somehow regarded as leading to a specific negative impact, would apply and impact any company irrespectively of their scope or activity (i.e., macroeconomic risks).

Two previous annual reports published were randomly revised with similar content, with the exception of the allusion to the Covid-19 pandemic; thus, a one-year publication was considered for this study. The authors carried out a joint examination of this section through a comprehensive and interpretative reading in order to screen and classify the main individual issues identified by these companies as risk factors for their prospects, by focusing on those risk factors that may be influenced by the nature of the business and leaving aside those that would apply to any company. Additionally, the overall potential consequences derived from such risks were identified. For the text classification of the main groups of risk factors, the authors leaned as a point of departure on the risk factor categorization adopted by Huang and Li (2011), consisting of a topic-based structure, and subsequently grouped and adapted it in accordance with the particular outcome and background. Thus, the outcome consisted of a list of raised risk topics with a brief description, gathering the most recurrently and emphasized risks declared by companies across the sample, along with other risks more seldomly reported by these companies, plus the overall potential consequences for their businesses.

#### **4. FINDINGS AND IMPLICATIONS**

The companies examined did report an extensive set of bullets or topics that may bring risks to their business. The general risk factors (i.e., economic downturn, recession, financial crisis, logistics crisis, energy or raw materials price increase, catastrophes, etc.) are here collected only in case they have some special significance for these companies in relation to the nature of their business when comparing to other companies in other industries, with different scope and activity.

Table 1 presents the results of the analysis with the risk factors reported by each company, classified by categories, factors that are particularly relevant or inherent to these companies to a more or less degree.

**Table 1.** Risk factors

Risk factor	Assessment				
	AMAZON	GOOGLE	IBM	MICROSOFT	ALIBABA
<b>Technological risks:</b>					
-Rapid technological advances/disruption	YES	YES	YES	YES	YES
<b>Business models risks:</b>					
-Rapidly evolving market, emerging business models	YES	YES	YES	YES	YES
<b>Competition risks:</b>					
-Low entrance barriers to new products, services, and business models, favored by new technologies	YES	YES	YES	YES	YES
-Alliances, acquisitions, consolidations within the industry	YES	YES	YES	YES	YES
<b>Investments risks:</b>					
-Uncertainties in investments in new products and services or new markets, not commercially viable, not attracting the interest of users to generate the revenue required to succeed, or without an adequate return of capital	YES	YES	YES	YES	YES
<b>Innovation risks:</b>					
-Failure of developing, implementing, or commercializing innovation initiatives	YES	YES	YES	YES	YES
<b>Integration risks:</b>					
-Integration challenges and other risks from mergers, acquisitions, alliances, and dispositions	YES	YES	YES	YES	YES
<b>International and expansion risks:</b>					
-Difficulties to manage international growth and expansion	YES	YES	YES	YES	YES
-Risks for continuous business expansion into a variety of new fields	NO	YES	NO	NO	YES
Lower levels of use of the Internet in certain countries	YES	NO	NO	NO	NO
<b>Volatile/cyclical demand:</b>					
-Changes in user/consumer needs, demands, or expectations	YES	YES	NO	YES	YES
-Seasonality demand (i.e., holidays) or peaks that can make systems collapse or affect results	YES	YES	YES	NO	YES

<b>Financial risks:</b>					
-Difficult to predict the company's financial results for particular periods (return of investments, sales cycles, and seasonality of technology and purchases, with new products, new customers, and new and evolving competitors)	YES	YES	YES	NO	YES
-Expenditures by advertisers tend to be cyclical, reflecting overall economic conditions and budgeting and buying patterns	NO	YES	NO	NO	NO
-Payment uncertainties. Need for a secure and trusted payment method	YES	YES	NO	NO	YES
-Risk of working with governmental entities as clients, who depend on fundings, with unfavorable provisions for the company (higher liabilities, unilateral termination of the contract...), or risk of being suspended as a governmental contractor	NO	NO	YES	YES	NO
<b>Security risks:</b>					
-Cybersecurity threats, increasingly sophisticated and complex, ( cyberattacks, viruses, spyware, spam, outages, etc.) causing security and privacy breaches and threat, data leakage/damage/lost, privacy threat, poorer or interrupted service...	YES	YES	YES	YES	YES
<b>Stakeholders risks:</b>					
-Dependance on stakeholders' practices. Risk on how stakeholders collect, store and use contents, data and service (i.e., disinformation, low-quality contents...). Difficult to fulfill the obligation to monitor and detect the inappropriate contents, copyrights, trademarks or patents infringement	YES	YES	YES	YES	YES
-Risk of stakeholders violating laws, regulations, contractual terms, intellectual property rights...	YES	YES	YES	YES	YES
-Websites violate or attempt to violate our guidelines, including by seeking to inappropriately rank higher in search results than our search engine's assessment of their relevance and utility would rank them (web spam)	NO	YES	NO	NO	NO

-Dependance on third-party providers and other suppliers. Need to attract or retain them	YES	YES	YES	YES	YES
-Dependance on third-party distribution channels (distributors, resellers, independent software vendors, independent service providers...)	YES	YES	YES	YES	NO
-Failures on data encryption. Dependance on third parties-providers	YES	NO	NO	NO	NO
<b>Potential product/services defects and reliability risks:</b>					
-Risks of products defects, quality or reliability problems, security issues or delivery failures, claims or disputes with clients and other stakeholders, product/service warranty or liability	YES	YES	YES	YES	NO
-Interdependence of products and services that magnifies the impact of quality and reliability issues	NO	NO	NO	YES	NO
-Dependence on reliability, security, and pricing of the Internet, telecommunications and computer infrastructure, operational failures, and dependence on third-party service providers	YES	YES	YES	YES	YES
-Vulnerability of products and services caused by interruptions due to modifications or upgrades, terrorist attacks, natural disasters or pandemics, climate change effects, power loss, telecommunications failures, cyberattacks...	YES	YES	YES	YES	YES
<b>Operational risks:</b>					
-Company data center networks and capabilities difficult to cope with demand and expansion	YES	YES	NO	YES	NO
-Risk during implementation of a new ERP system in the company	NO	YES	NO	NO	NO
Increase of remote working increases risks (i.e., access challenges)	NO	YES	YES	NO	NO
<b>Ethical risks:</b>					
-Products, services or business practices regarded as unethical	YES	YES	NO	NO	NO



-Artificial intelligence ethical issues	NO	YES	NO	YES	NO
<b>Human resources risks:</b>					
-Dependence on skilled employees. Difficulties to keep and attract talent, trained, motivated and capable, sharing company culture, mission, vision, and values. Competition between companies. Need to expand the roles of existing employees	YES	YES	YES	YES	YES
<b>Regulation risks:</b>					
-Laws, rules, and regulations. Complex, rapidly evolving, difficult to interpret, subject to uncertainties, different across countries or regions, or inconsistent. Potential/ongoing lawsuits	YES	YES	YES	YES	YES
-Protectionism by governments (trade restrictions, intellectual property rights, or patents...)	YES	YES	YES	YES	YES
<b>Intellectual property rights and licensing related risks:</b>					
-Difficult to adequately protect patents and intellectual property rights for the company and obtain and keep their license. Difficult to protect from copies	YES	YES	YES	YES	YES
-Risk of losing protection of trademark or trade secrets	YES	YES	NO	YES	YES
-Risk of intellectual property or patents claims against the company	YES	YES	YES	YES	YES
-Utilization of open source and other third-party software licensed with limited or no warranties, indemnification, or other contractual protections for the company	NO	NO	YES	NO	NO
-Claims about business practices and initiatives, product releases, and technologies adopted....	YES	YES	YES	YES	YES
-False statements or complaints about the company, products, and services	NO	NO	NO	NO	YES
<b>Sustainability risks:</b>					
-Not successful sustainability initiatives	YES	NO	NO	NO	NO

Source: Own elaboration

Moreover, Table 2 collects the overall potential consequences on the business of such risk factors.

**Table 2. Potential consequences**

Potential consequences	Assessment				
	AMAZON	GOOGLE	IBM	MICROSOFT	ALIBABA
Public scrutiny, negative publicity, and reputational harm	YES	YES	YES	YES	YES
Trust and engagement	NO	YES	NO	YES	YES
Increased regulatory scrutiny, investigations, and government inquiries	YES	YES	YES	YES	YES
Change of business practices	YES	YES	NO	YES	YES
Deviation of human and economic resources, increased operation costs	YES	YES	YES	YES	YES
Reduced efficiency/productivity	YES	YES	YES	YES	YES
Deviation of management resources	YES	YES	NO	YES	NO
Difficulties to innovate	NO	YES	YES	YES	NO
Harm to competitive position. Difficulties to compete	YES	YES	YES	YES	YES
Affection to offered products and services or pursuance of certain business models	YES	YES	YES	YES	YES
Affection to market share growth	NO	YES	NO	YES	YES
Loss of customers	YES	YES	YES	YES	YES
Additional taxes and expenses	YES	YES	YES	YES	YES
Fines, sanctions, penalties, or criminal liabilities	YES	YES	YES	YES	YES
Affection to business growth	YES	YES	YES	YES	YES
Affection to economic results (sales, revenues, profits)	YES	YES	YES	YES	YES
Affection to long-term success	NO	YES	YES	NO	NO

Source: Own elaboration

Most of the risk factors and their potential impacts reported are shared across the firms examined and presented in similar terms. This is in line with Campbell et al. (2014), who concluded that the public availability of the disclosures decreases information differences.

In general, the reports appear sound and logical to the audience. As a positive example, companies refer to the risks related to rapid changes, technological advances, or new business models, addressing the risk of offering customers more than they actually need, require, or are willing to pay for, which is one of the potential problems identified in the literature for various leading companies that have failed at offering disruptive technologies (i.e., Christensen, 2013).

Another positive outcome is that companies appear to update their disclosures depending on the context, instead of merely copying and pasting reports over years. One clear example of it is the reference found to certain risk factors aggravated by the Covid-19 pandemic or to recent cases of litigations as proof of the reported risk factors.

However, it does not mean the list is exhaustive enough for all companies examined or that all the actual risks are covered. One striking finding in this direction is that three out of the five companies examined do not refer at all to the ethics related to the use of artificial intelligence as a factor risk, whereas the artificial intelligence ethics and its responsibility is a trending topic among scholars and practitioners (i.e., Orr & Davis, 2020). Likewise, three of these companies do not report the possibility that their products, services, or business practices may be regarded as unethical. In turn, the ethical approach when facing the adoption of new technologies is however one of the raising concerns in our society and an identified difficulty or barrier for companies embracing them (i.e., Garcia-Ortega et al., 2021). In addition, considering the apogee and rising relevance of sustainability in our world, only one of these companies gives significant consideration to it as a risk factor, in terms of sustainability initiatives potentially not being successful.

As for main implications, these findings may serve as a reference for high tech companies and their senior management to deeper assess and become more self-aware of the risks and challenges they face when embracing high technologies and the relevance of reporting them in an appropriate and comprehensive manner, to be transparent and also protect their companies from future litigation. It can be also of interest to shareholders and other stakeholders to better appraise them and make better-informed decisions accordingly. In addition, this work aims to encourage the adoption of this underexplored approach among scholars and to foster the discussion about how to further improve such disclosures.

## **5. ORIGINALITY AND VALUE OF THE PAPER**

We propose an underexplored approach, by putting the spotlight on the identification and classification of the inherent risk factors identified by companies offering new, avant-

garde, or disruptive technologies such as cloud computing services, instead of considering the risks for companies adopting such high and new technologies offered, which have been in turn more widely investigated.

Thus, we offer a classification of the intrinsic risks from the cloud computing providers' perspective related to the specific nature of these companies, grouped by subjects, along with the potential derived negative impacts on their businesses, and critically discuss some positive aspects and some potentially missing factors to be further addressed by companies.

Finally, through this paper, we prepare the avenue for ongoing research including more companies and further assessment methods and criteria to further expand and enrich the findings.

## 6. RESEARCH LIMITATIONS AND FUTURE RESEARCH DIRECTION

For future research, we plan to expand the sample, considering more companies to reduce the bias of examining a limited number of companies. Likewise, although the contents in the two previous years were found similar for the companies analyzed, the time frame may also be expanded, and the effects on risks disclosure of certain events may be also assessed. The use of software for content analysis and algorithms (i.e., Huang and Li, 2011) may help for further assessment of larger samples and to reach further findings.

Furthermore, the criteria to determine which risks might be somehow intrinsic to the nature of the business, although quite intuitive, could be further supported by comparing the identified risks with those reported in other industries.

Lastly, future research may address more specifically the subcategories addressed within each risk factor group, the relations between them, and the derived impacts of each category and subcategories of risks on businesses.

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### *Conflict of interests*

The authors declare no conflict of interests.

## **AUTHOR CONTRIBUTIONS**

Beatriz Garcia-Ortega and Daniel Catala-Perez: Design, conceptualization, formal analysis, and findings and implications.

Blanca de-Miguel-Molina y Maria de-Miguel-Molina: Formal analysis, review, editing, and validation.

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