AI Technology Adoption & Sustainability Improvement Though Cloud Solutions

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Abstract: Cloud and AI are game changers in digital transformation, as it facilitates long-term digital development and technology adoption. A study of over 1000 organizations in Western Europe was conducted to identify company adoption of AI technology and cloud computing-based sustainability benefits. This paper offers the survey results and situates them within the larger context, showing how businesses employ cloud technology to achieve their AI and sustainability goals. Digital innovations such as AI technology are being realized via cloud services, allowing companies to better develop their product and services.

1 INTRODUCTION

There's a growing emphasis on artificial intelligence (AI) and cloud-enabled technologies. Organizations have doubled their use of AI capabilities, with a focus on robotic process automation and computer vision (Quantumblack, 2022). The environmental impact of technology, particularly data centres, is a growing concern (Wan, 2019). Cloud plays a critical role in AI systems' creation, implementation, and scalability, providing essential resources like computing power and storage (Hummer, 2019). Cloud facilitates collaboration for AI development and enables distributed workloads for faster processing (Gill, 2019). Cloud services offer a cost-effective and energy-efficient way to apply AI (Buyya, 2018). The pay-as-you-go model of cloud computing benefits businesses in accessing AI resources on demand (Attaran, 2019).

The flexibility of cloud technologies enhances AI innovation in various fields. Cloud is the ideal platform for AI, providing a broad data lake connection for cognitive capabilities (Montori, 2018). Cloud-based AI solutions leverage machine learning algorithms and big datasets for sophisticated decision-making (Allahvirdizadeh, 2019). Robotics also relies on the cloud, using AI and ML for automation (Lee, 2018). Automation, powered by cloud-based solutions, enhances productivity and streamlines operations (Ahmad, 2021). Cloud-hosted analytics solutions process IoT-generated data for data-driven decision-making (Antonopoulos, 2020). Cloud-based technologies collaborate to enable large-scale data gathering, analysis, and usage for sustainable decision-making.

AI implementation is in early stages, with companies recognizing its potential but facing social challenges. Cloud computing accelerates AI and supports environmental benefits by providing IT resources without hefty hardware investments (Ahmad, 2021). AI is making strides in the sustainable energy industry (Antonopoulos, 2020). Cloud operations prioritize renewable energy sources for data centres. However, challenges in AI implementation, connectivity to cloud technologies, and sustainability need industry attention (Muhlroth, 2020).

Despite AI's increasing adoption, there's a knowledge gap on its industry implications. Research areas include challenges in AI adoption, its impact on organizational culture, AI-driven automation in decision-making, organizational structure changes, AI's influence on value propositions and sustainability, innovation through AI, and ethical considerations (Enholm et al., 2021). An industry-oriented survey can fill these gaps, offering insights for effective AI implementation. This study focuses on the deployment of AI with a foundation in cloud computing and a sustainability perspective. It will look at how Western European (WE) businesses are progressing with AI technology adoption, on cloud-based innovation and its sustainability footprint. The research question we

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aim to answer is as follows:

How have AI enabling technologies based on cloud computing on West European companies been adopted and enabled sustainability?

This paper contributes to theory and practice in three ways. At first, we contribute to practice as research findings will be used to provide insights into the adoption of cloud based technologies IoT, Analytics, Automation, Robotics, ML, and AI by companies. This research will be beneficial to companies, as it will provide them with a better understanding of the potential of cloud driven AI for their sectors. Secondly, this paper will also explore the broader implications of cloud computing including examining the impact on enabling technologies as it looks into the impact of AI technologies and sustainability though cloud computing on industry-specific sectors, such as automotive and manufacturing. The final contribution is to the broader societal impact as it will explore the potential for start-ups and young companies in terms of innovation and market positioning, it will examine the state of AI technologies and sustainability of cloud for energy efficiency and carbon emission reduction. This paper continues with a literature review, followed by a methodology, analysis and conclusions section.

2 BACKGROUND

AI is a scientific discipline, technologies used to realize AI, and AI capabilities. AI emulates human performance by acting as an intelligent agent, which performs actions based on a specific understanding of input from the environment. This should be accomplished without relying on preconceived rules or action sequences throughout the whole procedure. AI is defined in two ways: as a tool that solves a specific task that could be impossible or very time-consuming for a human to complete, and as a system that mimics human intelligence and cognitive processes. advancements in AI have produced AI systems that are capable of persuading humans, even systems that are not explicitly designed to persuade may do so in practice,. (Burtell & Woodside, 2023). Using AI technology improves choice behaviour and increases perception of decision quality, but it creates the risk of overreliance, which may be explained by both a higher level of confidence in the adviser and the attribution of a more organized procedure (Keding 2021).

As AI gains prominence in organizations, research explores its role in achieving organizational goals, addressing both advantages and constraints (Kakatkar, 2020). AI capabilities involve leveraging data, methodologies, processes, and people for automation, decision-making, and collaboration. These capabilities encompass technological and non-technical resources, highlighting the need for holistic utilization to unlock AI's full strategic potential. However, the real-world implementation at the firm level, along with its connection to cloud and sustainability, remains unclear. A mixed-method approach, incorporating interviews, is recommended for future studies to gain comprehensive insights (Assunta di Vaio, 2020).

Cloud computing has emerged as a game-changing technology that offers significant benefits to businesses and is a core enabler for AI technologies. It allows for virtually unlimited capacity to process large amounts of data, enabling the use of new technologies such as machine learning and big data analytics (Kaisler et al., 2013). Scalability allows for ramping up or down of capacity as needed without major adjustments, increasing flexibility and the ability to handle peak workloads (Armbrust et al., 2010). The cloud also facilitates experimental approaches that require computational power, increasing potential for innovation (Marston et al., 2011). Additionally, cloud technology reduces IT costs by eliminating or reducing hardware purchases, potentially increasing sales while decreasing costs (Aljabre, 2017). Cloud technology also strengthens the resilience of businesses by improving cost control and response capabilities to changing market events (Cao et al., 2014). Finally, the cloud contributes to sustainability by providing better energy balance and data security, particularly if the provider relies on renewable energy sources (Bardhan et al., 2010). Despite the numerous benefits of cloud computing, research suggests that businesses have been slow to adopt this technology due to concerns about data security and privacy (Goscinski et al., 2011). In terms of the impact of cloud computing on digital transformation, research has shown that cloud adoption can enhance digital capabilities, particularly in terms of data analytics, collaboration, and mobility (Gupta et al., 2019). Additionally, there is a lack of understanding about the costs and benefits of cloud computing and how it can be effectively integrated into existing IT infrastructure (Chang et al., 2013). Research has also shown that the impact of cloud computing on businesses varies depending on the specific context and industry (Lacity et al., 2010). Adoption of cloud computing had a positive impact on firm performance in the financial services industry, but not in the manufacturing industry (Kshetri, 2014). Cost and energy savings of cloud computing can have a significant impact on businesses, by reducing the need for hardware and IT staff, businesses and increase profitability (Agrawal et al., 2013). However, it is important to note that the cost savings associated with cloud computing may not be immediate, and businesses must carefully consider the total cost of ownership over the long term (Weill et al., 2013). AI is rapidly evolving, offering businesses benefits like sustainability, but also challenges and risks. Companies must consider their context, industry, legal, and regulatory requirements when adopting AI technologies, contributing to the literature on AI implementation in WE companies. The present study aims to address this gap in the literature by examining the impact of cloud computing on WE companies in terms of digital transformation, innovation, cost savings, data security, and resilience.

3 METHODOLOGY

We collected data on the use of AI technologies and sustainability in WE (Benelux and Germany) companies in a large-scale digital survey. Companies are asked about the use of various AI technologies and sustainability enabled by cloud. Additionally qualifying questions on revenue and employee developments as asked. This allows statistically significant correlations to be revealed from the context of the survey without revealing these correlations to the companies during the survey, to avoid suggestive contexts. As part of the research project to determine the significance of cloud, over 1000 WE companies are interviewed in 2022 for this purpose in a digital survey. Participating companies are sampled in a random drawing stratified with respect to industry and size categories. Stratification is necessary to ensure that even marginally populated classes (firms with more than 200 employees) have enough cases. The final data is extrapolated to be representative of the overall WE are using number weighting so that the survey results can be interpreted beyond the sample for the WE economy. The anchor variable here is the industry class composition in the industries Services and Production.

In preparation for the extensive survey, case study interviews were conducted with selected company representatives who have gained extensive experience with the use of cloud services in the recent past. Case study interviews belong to the group of qualitative research methods. They are suitable for deep examination. In contrast to the company survey explained above, the case study interviews do not aim to determine a representative picture of cloud use and effects in WE companies that can be derived on the basis of large numbers but rather, in the sense of an in-depth investigation, to explore further effects (which, for example, cannot be collected in detail as part of the standardized survey) as well as concrete enrichment in the form of individual experience reports, concise success stories, and precise effect descriptions. In this way, the number-based results of the survey analogous categories were used for the presumed effects of cloud use enabling new technologies. These categories were refined using stimulus questions and tested for connectivity to the survey questions. As the WE corporate landscape is largely made up of service companies with a small number of employees, it is precisely these companies that are given greater weight in the survey. Weighting is used to calibrate the industry and size class composition of the sample to the composition of the population. Company information is subjective in nature. The data collected in the business survey will be used to approximate reality and make data-based deductions. The logic of the survey is based on a top-down approach, including the various survey blocks (i.e., introduction, company profile, key points of cloud use, concrete effects and examples, summary, outlook and further procedure, adoption) defined. The corresponding text and question formulations were then created for these individual blocks.

Identify and recruit interview participants The pool of interview participants was fed from two sources. On the one hand, particularly interested cloud users were approached directly; on the other hand, a number of participating cloud customers also agreed to be available for an additional case study interview during the survey. As a matter of principle, care was taken to ensure a broad composition of the participant pool in order to take into account different perspectives, industries, company sizes and locations. These participants were contacted by email and briefly introduced to the objectives, key points, and content of the case study interviews in advance. The surveys were conducted digitally and input lasted approximately 40 to 60 minutes. Participants were encouraged to be specific about their own experiences, focusing on the key points of cloud use, and the significance for the company. The answers were then evaluated; for this purpose, a number-based statistical analysis of the survey based on the interview logic and the use of cloud services was used.

4 ANALYSIS

This section focuses on presenting the findings derived from the data and providing a comprehensive understanding of the research topic. We will now present the collected data as examined, interpreted, and analysed to address the research objectives. The analysis data has been prepared by cleaning and organizing the collected data, including checking for missing values, outliers, and data inconsistencies. The data has been visualized by graphs to present the analysed data visually, to help convey the findings in a concise and accessible manner. The visualization is accompanied by an interpretation of findings to explain the meaning and implications of the analysed data. To connect the findings back to the research objectives, discusses any unexpected or significant results. For the technology adoption questions there are 4 categories of adoption which are measured in the percentage of companies are at this level of adoption, very strong (Company level), Strong (Business level), Limited (Team level), and Very Limited (PoC). Please find the results of technology adoption described per topic.

4.1 Industry Adoption of AI

There are many challenges to AI adoption, including a lack of understanding and competence, privacy concerns, cost, resistance to change, and ethical and legal difficulties. The following graph provided illustrates the percentage of cases where AI adoption is categorized into different levels of strength within each industry. The industries represented in the graph are Resources & Pharma, Electronics & Mechanics, Vehicles, Other manufacturing, ICT-Hardware & Services, Utilities & Construction, Trading, Logistics, Tourism, Service providers, and Banks & Insurance.

The data presented in graph 1 provides insights into the levels of AI adoption across different industries. From the analysis, several observations can be made. The percentages of AI adoption vary significantly across industries. Some industries, such as Electronics & Mechanics and ICT-Hardware & Services, show higher levels of adoption across all categories, including "Very Strong," "Strong," "Limited," and "Very Limited." On the other hand, industries like Other Manufacturing and Tourism exhibit lower levels of adoption, particularly in the "Very Strong" and "Very Limited" categories.

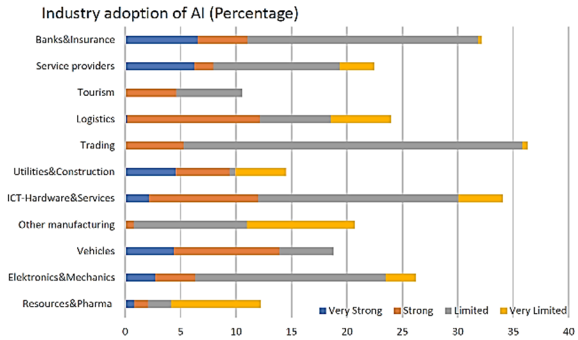

Figure 1: Industry adoption of AI (%).

There is a dominance of Limited Adoption in several industries, including Resources & Pharma, Utilities & Construction, Trading, and Service Providers; "Limited" adoption appears to be the most prevalent category. This suggests that many organizations in these industries have implemented AI to some extent, but the adoption may not be uniform across all strength levels. The data also reveals variations in AI adoption patterns among different industries, such as the dominance of "Very Strong" and "Strong" adoption in Electronics & Mechanics, indicating a more advanced level of implementation. The Resources & Pharma industry shows lower percentages across all adoption categories, suggesting a slower uptake of AI technologies. The following graph in fig 2 provides an overview of the company size distribution of AI adoption. It shows that AI adoption varies across company size, with larger companies having higher percentages of "Strong" and "Limited" adoption. The percentages of "Very Strong" adoption are relatively low across all company sizes, indicating a limited implementation of AI.

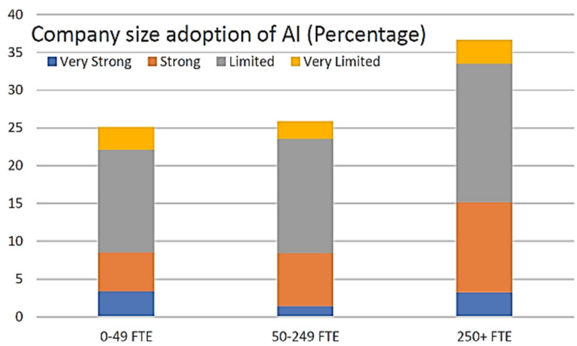

Figure 2: Company size adoption of AI (%).

Lastly we would like to show the company age distribution for the adoption of AI in fig 3, showing younger organizations have a higher likelihood of implementing AI solutions. Whilst the intensity of implementation does differ much over age. the data highlights the varying degrees of AI adoption across industries. It indicates that while some industries have made significant strides in AI implementation, others are still in the early stages or have limited adoption.

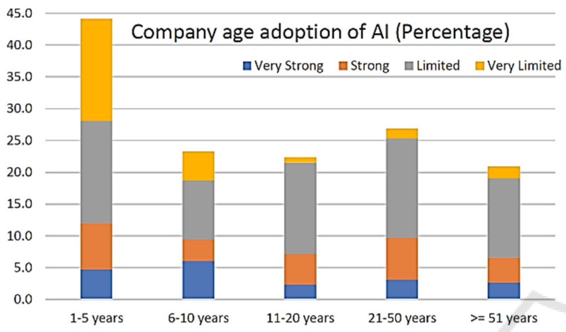

Figure 3: Company size adoption of AI (%)

In conclusion, larger and younger organizations tend to have the highest likelihood of implementing AI, especially if they are active in Electronics Vehicles production, Utilities construction or banking services industries. Understanding these patterns can help policymakers, researchers, and industry leaders in identifying opportunities and formulating strategies to promote AI adoption and its potential benefits across diverse sectors.

4.2 Industry Adoption of ML

Machine learning has the potential to transform the way organizations run, but there are significant barriers to its widespread adoption. These difficulties include a lack of data quality, a paucity of personnel, regulatory issues, explainability, and prejudice. The following graph in fig 4 illustrates the percentage of cases where ML adoption is categorized into different levels of strength within each industry. The industries represented in the graph are Resources & Pharma, Electronics & Mechanics, Vehicles, Other manufacturing, ICT- Hardware & Services, Utilities & Construction, Trading, Logistics, Tourism, Service providers, and Banks & Insurance.

From the chart the percentages of ML adoption several conclusions can be drawn. The data reveals that the distribution of ML adoption varies across industries. Some industries, such as Resources & Pharma, Electronics & Mechanics, and ICT-Hardware & Services, exhibit a wider range of adoption levels across all categories, including "Very Strong," "Strong," "Limited," and "Very Limited." In contrast, industries like Tourism and Utilities & Construction show lower overall adoption percentages, with negligible or minimal ML adoption reported. Limited Adoption Dominance: In several industries, including Resources & Pharma, Electronics & Mechanics, and Banks & Insurance, the "Limited" adoption category represents the highest percentage. This suggests that organizations within these industries have adopted ML technologies to a certain extent but haven't achieved a widespread or intensive implementation. Notably, the "Very Limited" adoption category appears to have low percentages across most industries, indicating that organizations have either embraced ML at a higher level or have not yet started implementing ML solutions with limited scope. Each industry exhibits its own ML adoption pattern. For example, the Trading industry stands out with higher percentages of "Very Strong" and "Limited" adoption, indicating a more diverse range of adoption levels. On the other hand, the Tourism industry shows no reported ML adoption in any of the categories, indicating a lack of ML implementation in this sector.

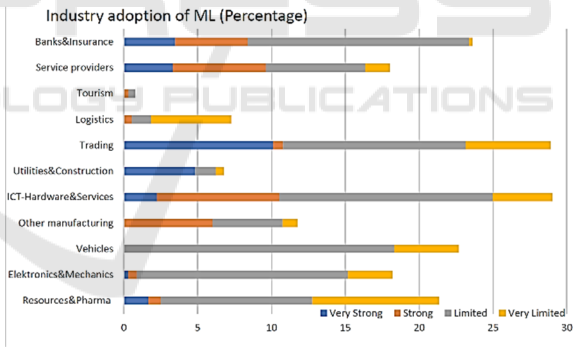

Figure 4: Industry adoption of ML (%).

The following graph in fig 5 provides an overview of the company size distribution of ML adoption. It shows that ML adoption varies across company size, with larger and medium companies having higher percentages of "Strong" and "Limited" adoption. The percentages of "Very Strong" adoption are relatively low across all company sizes, indicating a limited implementation of ML.

Lastly, we would like to show the company age distribution for the adoption of ML in fig 6, showing younger organizations have a higher like-lihood of implementing ML solutions. The intensity of implementation does differ strongly over age.

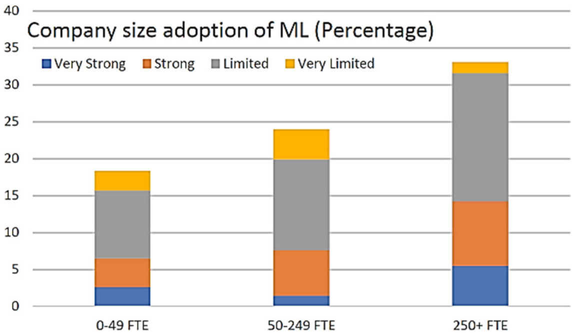

Figure 5: Company size ML adoption (%).

Comparative study of ML adoption across sectors, displaying the distribution of instances within each degree of adoption strength. various degrees of ML deployment, with certain industries having a greater number of examples with significant acceptance than others. This data can be useful for assessing the current level of ML usage in various industries and identifying areas where more investment may be required.

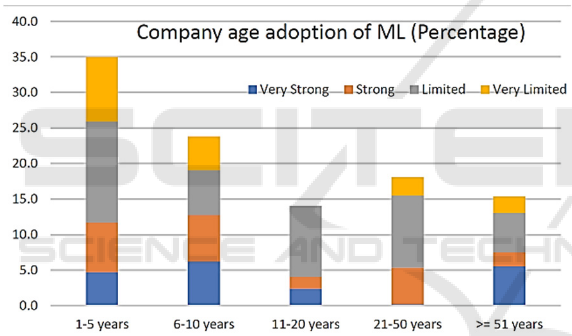

Figure 6: Company age adoption of ML (%).

Overall, the data demonstrates the various levels of ML usage across industries, where larger and younger organizations tend to have the highest likelihood of implementing AI, especially if they are active in Utilities/construction, Trading or banking/services industries. While some industries have made significant progress in ML deployment, others continue to lag or have limited acceptance. Understanding these trends can assist in informing decision-making processes, resource allocation, and strategic planning in order to encourage widespread ML use and its potential advantages in many industries.

4.3 Industry Adoption of Robotics

Robotics is facing challenges such as human-oriented interaction, building bio-based robots, multifunctionality, RPA management, and communication in swarm robots. Business leaders should encourage employees to interact with machines and take initiatives to deploy more human-friendly robots. Robots require communication abilities to be integrated into feedback loops, environment mapping, reasonable AI systems, privacy and security, implementation of the wrong RPA solution, and ethical values to be taken into account. The following illustrates the percentage of cases where robotics adoption is categorized into different levels of strength within each industry. The industries represented in the graph are Resources & Pharma, Electronics & Mechanics, Vehicles, Other manufacturing, ICT-Hardware & Services, Utilities & Construction, Trading, Logistics, Tourism, Service providers, and Banks & Insurance.

From the chart in fig 7 we can draw the following conclusions, the dominant category across most industries is "Limited" adoption, indicating that organizations have implemented Robotics to some extent but with restricted scope or scale. Industries such as Resources & Pharma, Electronics & Mechanics, Vehicles, Other Manufacturing, ICT-Hardware & Services, Utilities & Construction, Trading, Logistics, Service Providers, and Banks & Insurance exhibit higher percentages in the "Limited" adoption category. The "Very Limited" adoption category generally shows lower percentages across the industries, suggesting that organizations have either not yet started adopting Robotics or have only implemented it at a minimal level. Notable examples of this trend can be seen in the Resources & Pharma, Electronics & Mechanics, Vehicles, Other Manufacturing, ICT-Hardware & Services, Utilities & Construction, Tourism, and Service Providers industries. The Trading industry stands out with a relatively higher percentage of "Very Strong" adoption, indicating a more significant implementation of Robotics compared to other industries.

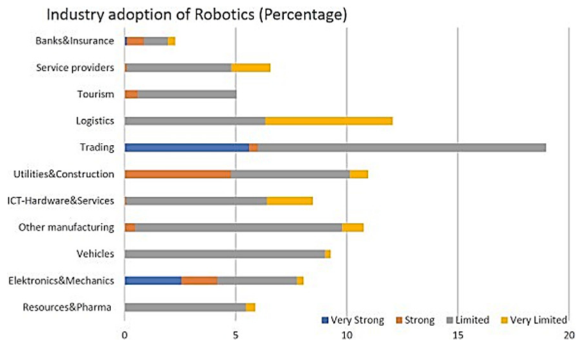

Figure 7: Industry adoption of Robotics (&).

Similarly, the Utilities & Construction industry shows a higher percentage of "Strong" adoption, implying a more advanced level of adoption in this sector. The data indicates that Robotics adoption varies across industries, with some industries reporting higher adoption levels and others reporting minimal or no adoption. This suggests that certain industries may have a higher propensity for leveraging Robotics technology, possibly due to operational requirements or their business processes. The following graph in fig 8 provides an overview of the company size distribution of Robotics adoption. It shows that Robotics adoption varies across company size, with larger companies having higher percentages of "Strong" and "Limited" adoption. The percentages of "Very Strong" adoption are relatively low across all company sizes, indicating a limited implementation of Robotics.

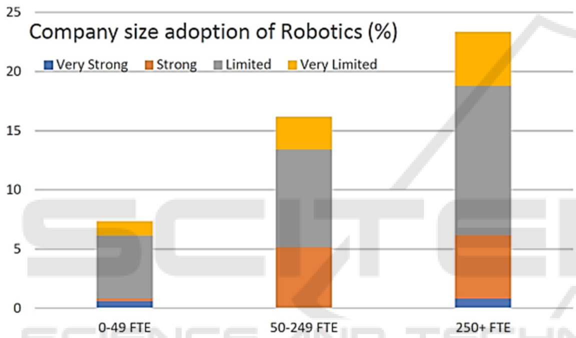

Figure 8: Company size adoption of Robotics (%).

Lastly, the company age distribution for the adoption of Robotics, showing older organizations and 6-10 year old companies have a higher likelihood of implementing Robotics solutions is being shown in fig 9.

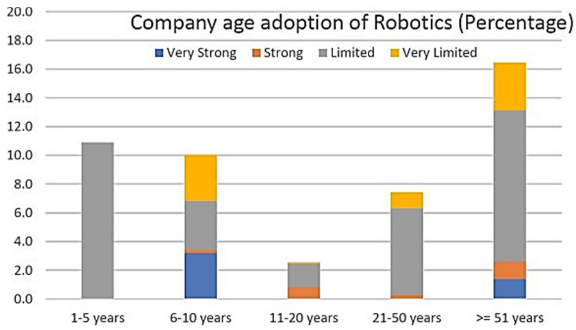

Figure 9: Age company Robotics adoption (%).

Comparative study of Robotics adoption across sectors, displaying the distribution of instances within each degree of adoption strength. various degrees of Robotics deployment, with certain industries having a greater number of examples with significant acceptance than others. This data can be useful for assessing the current level of Robotics usage in various industries and identifying areas where more investment may be required.

Overall, the data demonstrates the various levels of Robotics usage across industries, where larger and younger organizations tend to have the highest likelihood of implementing robotics, especially if they are active in Trading, Utilities/Construction, or Electronics & Mechanics industries. This data provides valuable insights into the current landscape of Robotics adoption in different sectors and can guide decision-making, investment strategies, and resource allocation to promote broader adoption and maximize the potential benefits of Robotics in various industries.

Industry Adoption of Automation. Resource and talent availability is a major obstacle to automation adoption, with few having the right skills to benefit from automation. Mastering digital skills, and budgetary restraints are the top barrier to limiting automation. It is important for members of the C-suite to grow their IT knowledge and communicate with the frontlines of IT and business to allocate resources and hands-on support appropriately. The following graph in fig 10 illustrates the percentage of cases where Automation adoption is categorized into different levels of strength within each industry. The industries represented in the graph are Resources & Pharma, Electronics & Mechanics, Vehicles, Other manufacturing, ICT-Hardware & Services, Utilities & Construction, Trading, Logistics, Tourism, Service providers, and Banks & Insurance. From the provided data, several conclusions can be drawn regarding automation adoption across different industries. The table demonstrates that the percentages of automation adoption vary significantly among industries. Some industries show higher levels of adoption across all categories, such as Tourism with 22% adoption in the "Very Strong" category. On the other hand, certain industries exhibit lower adoption percentages, like Utilities & Construction with only 6% in the "Strong" category.

Across most industries, the combined percentages of "Strong" and "Limited" adoption are relatively high. This indicates a substantial implementation of automation technologies in various sectors, with Electronics & Mechanics, ICT-Hardware & Services, and Trading industries displaying notable percentages in both categories.

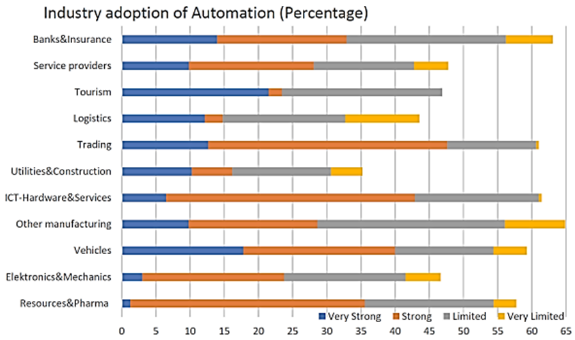

Figure 10: Industry adoption of Automation (%).

The data suggests that the "Very Strong" adoption of automation technologies is less prevalent across industries. However, some sectors stand out with notable percentages in this category, including Vehicles (18%), Tourism (22%), and Banks & Insurance (14%). There are instances where industries have significant percentages of adoption falling under the "Limited" and "Very Limited" categories. Notably, the Other Manufacturing industry demonstrates a substantial proportion of adoption in these categories, with 27% in the "Limited" and 9% in the "Very Limited" categories. Each industry has its own unique pattern of adoption. For example, the Resources, Pharma, Electronics & Mechanics, and ICT-Hardware & Services industries have a higher concentration of adoption in the "Strong" category. Conversely, the Logistics industry shows higher adoption in the "Very Limited" category compared to others.

The following graph fig 11 provides an overview of the company size distribution of Automation adoption. It shows that Automation adoption varies across company size, with larger companies having higher percentages of "Strong" and "Limited" adoption. The percentages of "Very Strong" adoption are relatively low across all company sizes, indicating a limited implementation of Automation.

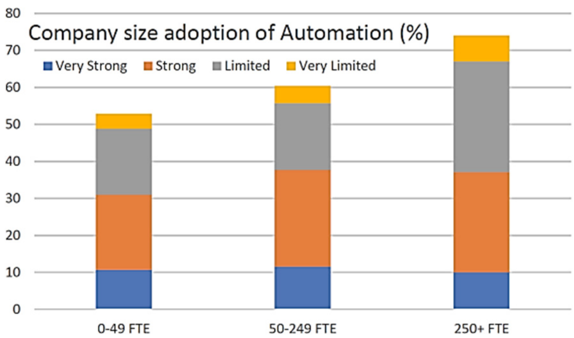

Figure 11: Adoption of Automation (%).

Lastly, we would like to show the company age distribution in fig 12 for the adoption of Automation, showing organization age not having a strong influence on the likelihood of implementing Automation solutions, with a positive outlier on the 6-10 year aged organizations.

In conclusion, the data reveals that automation adoption varies across industries, with some sectors demonstrating higher rates of adoption in the "Strong" and "Limited" categories, while others have lower adoption levels or a greater percentage of cases falling into the "Very Limited" category. This indicates the presence of industry-specific trends and highlights the need for further investigation into the factors influencing adoption patterns. Larger organizations tend to have the highest likelihood of implementing Automation. Understanding these variations can help guide decision-making and resource allocation to promote increased automation implementation where needed.

4.4 Industry Adoption of Analytics

To improve decision making, data must be examined through analytics. However, there are significant Data problems that businesses face. These include data quality, storage, a paucity of data science personnel, data validation, and data aggregation from many sources. The graph provided illustrates the percentage of cases where analytics adoption is categorized into different levels of strength within each industry. The industries represented in the graph are Resources & Pharma, Electronics & Mechanics, Vehicles, Other manufacturing, ICT-Hardware & Services, Utilities & Construction, Trading, Logistics, Tourism, Service providers, and Banks & Insurance. In fig 13 the adoption of analytics in the Resources, Pharma industry is shown to be relatively low, with the majority of cases falling under the "Limited" adoption category.

The Electronics & Mechanics industry has a balanced distribution of analytics adoption across all categories, but the percentage of cases with "Limited" adoption is the highest. The Vehicles industry shows a moderate level of analytics adoption, similar to the Vehicles industry. Other Manufacturing is distributed across all adoption categories, but the percentage of cases with "Limited" adoption is the highest. ICT-Hardware & Services industry stands out with a significant analytics adoption.

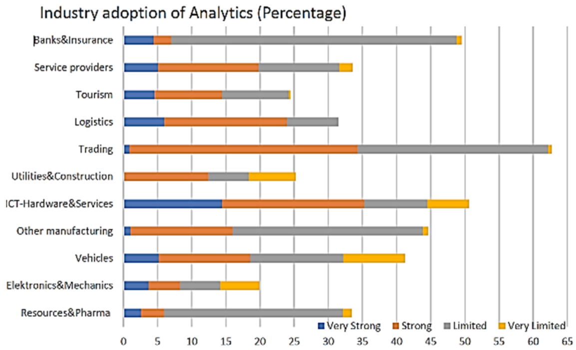

Figure 13: Industry adoption of Analytics (%).

The Trading industry has a high percentage of cases with "Limited" and "Very Limited" analytics adoption. The Logistics industry is relatively balanced across the "Strong," "Limited," and "Very Limited" adoption categories. The Tourism industry demonstrates a distributed adoption of analytics across all categories, with a significant percentage of cases falling into the "Limited" adoption category. The Service Providers industry has a relatively balanced distribution of analytics adoption.

The following graph provides an overview of the company size distribution of Analytics adoption. It shows that Analytics adoption varies across company size, with larger companies having higher percentages of "Strong" and "Limited" adoption. The percentages of "Very Strong" adoption are relatively low across all company sizes, indicating a less widespread implementation of Analytics.

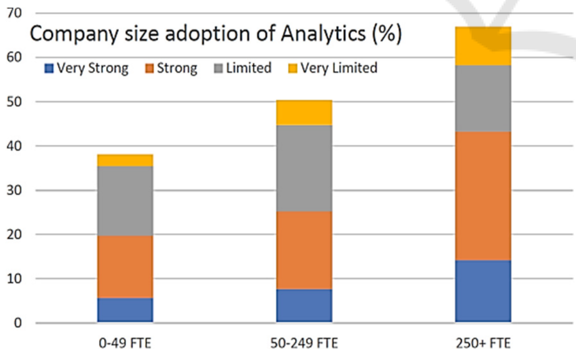

Figure 14: Analytics Adoption company size(%).

Lastly, we would like to show the company age distribution for the adoption of Analytics, showing younger organizations have a higher likelihood of implementing Analytics solutions. Whilst the intensity of implementation does not differ much over age.

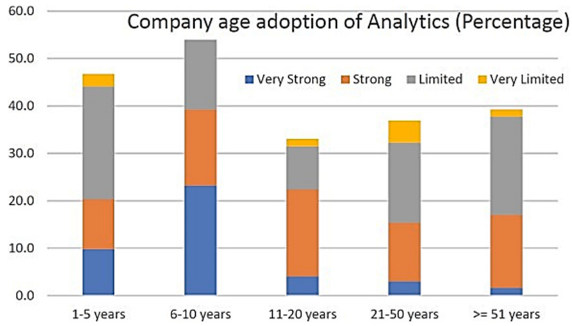

Figure 15: Analytic adoption company size(%).

4.5 Industry Adoption of IoT

Data security and privacy are two of the most serious difficulties associated with IoT. Massive volumes of data are generated and collected by IoT devices, which may contain sensitive and personal information. This information may be subject to cyberattacks, breaches, theft, or misappropriation by hackers, rivals, or other parties. The following graph illustrates the percentage of cases where IoT (Internet of Things) adoption is categorized into different levels of strength within each industry. At the forefront of IoT adoption represented are the industries Trading and Vehicle-Manufacturing with near firm-wide adoption around 10 percent, followed by Electronics/Mechanics and Logistics at 5%. However at the business unit level also Other-Manufacturing, Utilities/Construction with near a quarter adoption, followed by ICT-hardware & Services are strongly represented at 12-16%. This level of adoption is reflecting how IoT enables improved productivity and operational efficiency. The top reasons companies have adopted IoT are increased efficiency of operations and increased employee productivity. Please review Figure 1 and table 4.2 for more details IoT adoption in Resources and Pharma is generally low, mostly categorized as "Limited." There is potential for growth in implementing IoT technologies. Electronics & Mechanics show moderate adoption, with a notable percentage in the "Limited" category, suggesting the need for further integration. The Vehicles industry has a mixed pattern, with a significant "Limited" adoption, indicating potential for more implementation. Other Manufacturing has a balanced IoT adoption, with notable cases in both "Strong" and "Limited" categories, but there is room for improvement. ICT-Hardware & Services demonstrate a moderate level of adoption, especially in the "Limited" category, indicating potential for further integration.

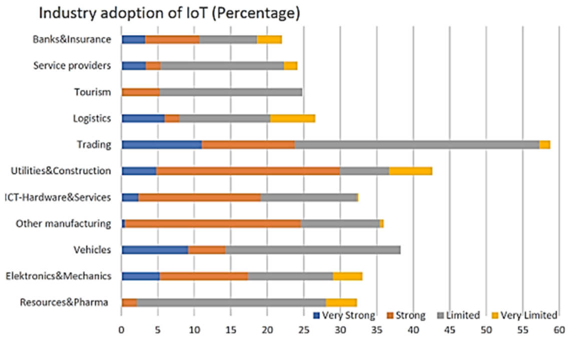

Figure 16: Industry adoption of IoT (%).

Utilities & Construction exhibit relatively high adoption, particularly in "Strong" and "Limited" categories. The Trading industry has a high percentage of "Limited" adoption, indicating a need for increased utilization. Logistics shows a balanced adoption, suggesting a moderate level of implementation.

In Tourism, there's notable "Limited" adoption, indicating potential for increased utilization. Service Providers exhibit balanced adoption, with room for improvement. Banks & Insurance show a moderate level of adoption across categories, suggesting further potential. The graph illustrates varied IoT adoption across company sizes, with larger and medium companies having higher percentages of "Strong" and "Limited" adoption. Medium-sized companies notably show strong implementation

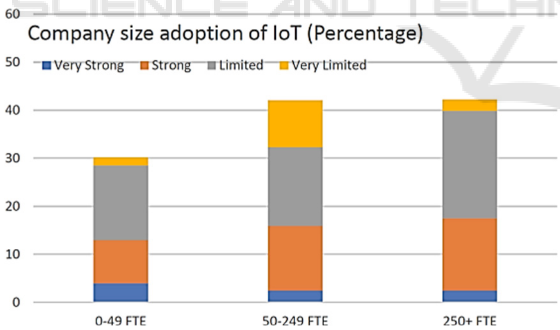

Figure 17: Company size adoption of IoT (%).

Lastly, we would like to show the company age distribution for the adoption of IoT, showing younger organizations have a higher likelihood of implementing IoT solutions.

In summary, the graph provides a comparative analysis of IoT adoption across different industries, showcasing the distribution of cases within each level of adoption strength. It highlights the varying levels of IoT implementation, with some industries having a higher proportion of cases with limited adoption, while others have a more balanced

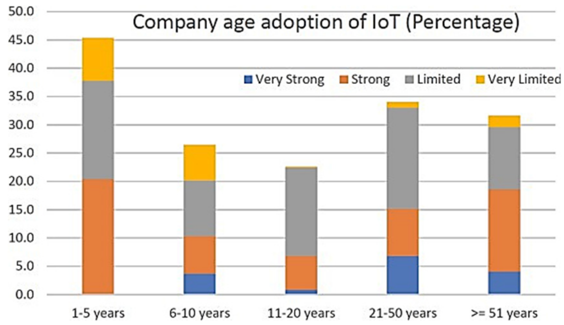

Figure 18: Company size adoption of IoT (%).

distribution across different adoption categories. Larger organizations tend to have the highest likelihood of implementing IoT, especially if they are active in Vehicles production or Trading industries. This information can be valuable for understanding the current state of IoT adoption in different sectors and identifying areas where furthr investment and implementation may be needed.

4.6 Cloud-Enabled Sustainability

Cloud computing has the potential to improve energy efficiency while emitting less greenhouse gases than on-premises IT systems. The following graph provided provides a comparative analysis of the percentage of cases where energy usage has decreased as a result of cloud usage, categorized by adoption strength and industry type. In the Resources & Pharma, Electronics & Mechanics, and Vehicles industries, most cases reported a reduction in energy usage, with percentages of 62.2%, 65.2%, and 69.8% respectively. Other manufacturing had a lower percentage (47.1%) indicating a decrease, while ICT-Hardware & Services stood out with a significantly high proportion (75.5%) reporting a decrease. The Utilities & Construction, Trading, and Tourism industries also showed a notable percentage of cases reporting a decrease in energy usage through cloud adoption, with percentages of 58.9%, 64.0%, and 58.5% respectively. Logistics and Service providers had slightly lower percentages (54.2% and 61.2% respectively), but still showed a significant reduction in energy usage. In contrast, the Banks & Insurance industry had a relatively high percentage (68.7%) indicating a decrease in energy usage, while the percentage of cases responding with no change was 31.3%. The fig 19, with YES on the left and NO on the right, provides a clear comparison of the percentage of cases reporting a decrease in energy usage through cloud adoption and those responding with no change in energy usage across different industries.

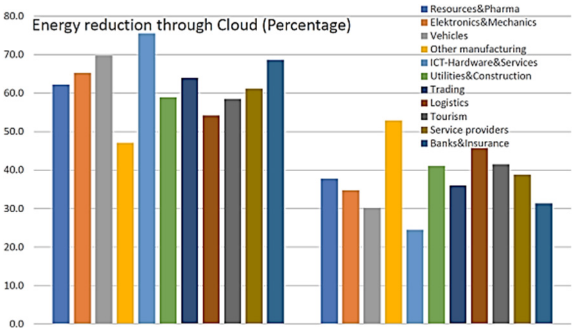

Figure 19: Cloud energy reduction (%).

We also examined the impact of cloud adoption on sustainable energy usage across various industries. One of the primary benefits of cloud storage is that it eliminates the need for physical infrastructure and equipment such as servers, cooling systems, and power supply. As a result, cloud storage can reduce the quantity of greenhouse gas emissions and waste produced by your data storage activities. The analysis shown in fig 20, with YES on the left and NO on the right, revealed a diverse range of outcomes, indicating that the relationship between cloud usage and sustainable energy usage is not uniform across industries. The following graph provides a comparative analysis of the percentage of cases where sustainable energy usage has increased because of cloud usage, categorized by adoption strength and industry type.

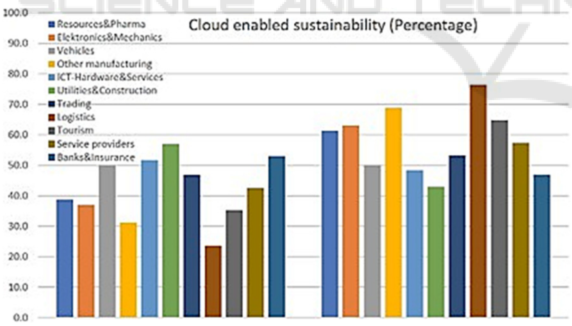

Figure 20: Cloud-enabled sustainability (%).

Among the industries investigated, Resources & Pharma exhibited a higher percentage (38.7%) of cases reporting an increase in sustainable energy usage due to cloud adoption. However, the majority (61.3%) responded negatively. Similarly, Electronics & Mechanics showed a similar trend, with 37.0% reporting an increase and 63.0% reporting no change in sustainable energy usage. Interestingly, the vehicles industry displayed an equal distribution, with 50.0% of cases reporting an increase in sustainable energy usage because of cloud adoption and an equal 50.0% responding negatively. Other manufacturing had a higher proportion (31.1%) reporting an increase, but the majority (68.9%) still responded negatively. In contrast, ICT-Hardware & Services showed a higher percentage (51.6%) reporting an increase in sustainable energy usage due to cloud adoption. Utilities & Construction followed suit, with 57.0% reporting an increase. However, both Trading and Tourism industries had a larger proportion responding negatively. Notably, Logistics had a relatively low percentage (23.5%) reporting an increase, while Service providers and Banks & Insurance had higher proportions (42.6% and 53.0% respectively) indicating an increase in sustainable energy usage. The findings suggest that the impact of cloud adoption on sustainable energy usage varies across industries. Factors such as industry-specific characteristics and implementation strategies likely contribute to this variation. Further research is needed to understand the underlying mechanisms and identify best practices for maximizing the positive effects of cloud adoption on sustainable energy usage in each industry. Such insights can inform decision-making processes and guide future sustainability initiatives in these sectors.

5 CONCLUSION

Digitization provides society and the economy with huge opportunities for growth and efficiency. Many business models, particularly those of new and innovative enterprises, would not exist without powerful cloud technologies such as AI. However, established businesses are increasingly profiting from digital technology. The increasingly visible impacts of a skilled labour scarcity can be mitigated by home offices, which can attract competent people from all over the world. However, digitalization incurs costs and has negative externalities. The high-power usage and related environmental impact can be major roadblocks here.

Sustainability initiatives should not be used to undermine digitization; both ideas must exist and function in tandem. This is where highly specialized technology firms come in, playing an increasingly important role in enabling boundary-pushing technologies while lowering environmental impact. Process automation solutions are available in 56 percent of businesses, while data analytics are available in 46.8 percent of businesses that feel very or moderately supported. Artificial intelligence is used by 15.2 percent of businesses, while machine learning is used by 14.2 percent and robotics is used by 6.2 percent, demonstrating how rapidly technologies are being embraced. There is a definite technological competence across all firms, and digital technologies are being implemented in every area. Cloud is assisting businesses in minimizing their environmental footprint by lowering energy requirements for 64.5 percent of businesses. Renewable energy sources are important to 38.9 percent of businesses. Particularly in view of additional increases in power use because of digitalization and the rising greener business models of cloud, the corporate landscape is projected to assist the corporate landscape decarbonize even more in the future.

The utilization of the cloud appears to help sectors rely on forward-thinking technology. Against the backdrop of the immense economic potential of industry's constant digitalization, cloud allows AI and sustainability, assuring firms have a fair chance of profiting. Organizations should convene a cross-functional group to identify and prioritize the highest-value use cases and enable coordinated and safe implementation across the organization. Companies must create scalable data architectures, upgrade current computing & tooling infrastructure, and build a "lighthouse" approach to take advantage of AI. Proof-of-concept is still the best way to quickly test and refine a valuable business case before scaling. Business leaders must balance value creation opportunities with risks associated with AI and prioritize use cases that align with their risk tolerance. Organizations need to adapt their working approach to handle the rapidly evolving regulatory environment and risks of AI at scale and partner with the right companies to accelerate execution. Companies need to experiment with and deploy innovative technologies at an early stage, establishing technology-based competitive edge based on these technologies. As a result, such businesses not only assure their own long-term existence but also contribute to the spread of new technology outside industry lines. Our study contributes to the literature on innovation management by putting light on the application of AI and machine learning algorithms in the future organization of innovation. Our findings suggest areas where AI systems may already be used to benefit organizational innovation.

REFERENCES

Agrawal, A., Gans, J., & Goldfarb, A., (2019) The Economics of Artificial Intelligence: An Agenda

Agrawal, R., Gopalakrishnan, A., & Gupta, M. (2013). The impact of cloud computing on IT outsourcing. MIS Quarterly Executive, 12(2), 61-72.

Ahmad, Tanveer, et al. "Artificial intelligence in sustainable energy industry: Status Quo, challenges and opportunities." Journal of Cleaner Production 289 (2021): 125834.

Aljabre, A. (2017). The impact of cloud computing on business performance: A conceptual framework. Journal of Economic and Administrative Sciences, 33(1), 22-36.

Allahvirdizadeh, Yousef, Mohsen Parsa Moghaddam, and Heidarali Shayanfar. "A survey on cloud computing in energy management of the smart grids." International Transactions on Electrical Energy Systems 29.10 (2019): e12094.

Antonopoulos, Ioannis, et al. "Artificial intelligence and machine learning approaches to energy demand-side response: A systematic review." Renewable and Sustainable Energy Reviews 130 (2020): 109899.

Armbrust, M., Fox, A., Griffith, R., Joseph, A. D., Katz, R. H., Konwinski, A., ... & Zaharia, M. (2010). A view of cloud computing. Communications of the ACM, 53(4), 50-58.

Assunta Di Vaioa, , Rosa Palladino, Rohail Hassan, Octavio Escobar (2020) Artificial intelligence and business models in the sustainable development goals perspective: A systematic literature review

Attaran, Mohsen, and Jeremy Woods. "Cloud computing technology: improving small business performance using the Internet." Journal of Small Business & Entrepreneurship 31.6 (2019): 495-519.

Bardhan, I. R., Jafarizadeh, S., & Talley, W. K. (2010). Cloud computing: implications for enterprise software vendors. Proceedings of the 2010 ACM Symposium on Applied Computing, 1531-1536.

Burtell, M., Woodside, T., (2023) Artificial Influence: An Analysis Of AI-Driven Persuasion. Computers and Society a r X i v :2303.08721

Buyya, Rajkumar, et al. "A manifesto for future generation cloud computing: Research directions for the next decade." ACM computing surveys (CSUR) 51.5 (2018): 1-38.

Cao, J., Yu, Z., Ma, Y., & He, Y. (2014). Impact of cloud computing on enterprise innovation: Empirical evidence from Chinese enterprises. International Journal of Information Management, 34(5), 626-640.

Chang, V., Walters, R. J., & Wills, G. (2013). The development that leads to the adoption of cloud computing in the UK SME sector. Journal of Small Business and Enterprise Development, 20(2), 296-312. Enholm, Papagiannidis, Mikalef, Krogstie.(2021) Artificial Intelligence and Business Value: a Literature Review

Gill, Sukhpal Singh, et al. "Transformative effects of IoT, Blockchain and Artificial Intelligence on cloud computing: Evolution, vision, trends and open challenges." Internet of Things 8 (2019): 100118.

Goscinski, A., Brock, M., & Tangasova, B. (2011). The challenges of cloud computing adoption. Proceedings of the 2011 International Conference on Parallel and Distributed Processing Techniques and Applications, 409-415.

Gupta, M., Agrawal, R., & Gopalakrishnan, A. (2019). Cloud computing and digital capabilities: A systematic review and future research directions.

Hummer, Waldemar, et al. "Modelops: Cloud-based lifecycle management for reliable and trusted ai." 2019 IEEE International Conference on Cloud Engineering (IC2E). IEEE, 2019.

Kaisler, S., Armour, F., Espinosa, J. A., & Money, W. (2013). Big data: issues and challenges moving forward. Proceedings of the 46th Hawaii International Conference on System Sciences, 995-1004.

Kakatkar, Chinmay & Bilgram, Volker & Füller, Johann, 2020. "Innovation analytics: Leveraging artificial intelligence in the innovation process," Business Horizons, Elsevier, vol. 63(2), pages 171-181.

Keding, Christoph & Meissner, Philip, 2021. "Managerial overreliance on AI-augmented decision-making processes: How the use of AI-based advisory systems shapes choice behavior in R&D investment decisions," Technological Forecasting and Social Change, Elsevier, vol. 171(C).

Kshetri, N. (2014). Cloud computing adoption by SMEs in the north-central United States. Journal of Global Information Management, 22(4), 17-34.

Lacity, M. C., Willcocks, L. P., & Kern, T. (2010). The value of selective IT sourcing. Sloan Management Review, 51(2), 75-83.

Lee, Ya-Ching. "Adoption intention of cloud computing at the firm level." Journal of Computer Information Systems 59.1 (2019): 61-72.

Marston, S., Li, Z., Bandyopadhyay, S., Zhang, J., & Ghalsasi, A. (2011). Cloud computing—The business perspective. Decision Support Systems, 51(1), 176-189.

Montori, Federico, et al. "Machine-to-machine wireless communication technologies for the Internet of Things: Taxonomy, comparison and open issues." Pervasive and Mobile Computing 50 (2018): 56-81.

Mühlroth, Christian & Grottke, Michael. (2020). Artificial Intelligence in Innovation: How to Spot Emerging Trends and Technologies. IEEE Transactions on Engineering Management. PP. 1-18. 10.1109/TEM.2020.2989214.

Quantumblack (2022), The state of AI in 2022—and a half decade in review, quantumblack/our-insights/the-state-of-ai-in-2022-and-a-half-decade-in-review?cid=app#review

Stephan Schlögl, Claudia Postulka, Reinhard Bernsteiner & Christian Ploder

Wan, J., Yang, J., Wang, Z., & Hua, Q. (2018). Artificial intelligence for cloud-assisted smart factory. IEEE Access, 6, 55419-55430.

Weill, P., Ross, J. W., & Robertson, D. C. (2013). Enterprise Architecture as Strategy: Creating a Foundation for Business Execution. Harvard Business Press.