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Postgraduate Dissertation

Analysis of the technology trends and opportunities in the digital  
world and how they influence the contemporary business

Charalampos Fougias

Supervisor: Ioannis Pollalis

Athens, Greece, May, 2025

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# Analysis of the technology trends and opportunities in the digital world and how they influence the contemporary business

Charalampos Fougias

## Supervising Committee

Supervisor:

Ioannis Pollalis

Hellenic Open University

Co-Supervisor:

Ioannis Spanos

Hellenic Open University

Athens, Greece, May, 2025

*Dedicated to it to my mother, whose tireless efforts and sacrifices made me who I am today, and to my wife and daughter who give me strength every day and make me a better person.*

*I would also like to acknowledge the contribution of my professor Mr. Ioannis Pollalis who was instrumental to his effort by always providing crucial advice and guidance.*

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## **Abstract**

In the modern era where we face rapid technological advancement, there are unprecedented opportunities and challenges for the businesses. In this dissertation, we will explore the role of the main emerging technological trends, such as Artificial Intelligence (AI) and Machine Learning (ML), Cloud Computing, Big Data Analytics, Internet of Things (IoT), and Blockchain in the contemporary business and how those technological advancements shape business practices and strategies. The aforementioned technologies are the ones that drive the digital transformation, are an integral part for improving the operational efficiency, play a significant role in innovation, and provide a competitive advantage to the ones that successfully employ them in this modern data-driven economy.

This dissertation will examine how those technologies are influencing the decision making processes, how they provide better collaboration and quick adaptation to market changes, how they provide better understanding of the customer behavior, how they help optimizing business strategy and how they provide transparency and security in all transactions.

By analyzing some case studies and industry applications, the dissertation highlights the impact those technologies have across various sectors, but also provides a critical view regarding the challenges businesses face by adopting them. The results of the analysis shows that the strategic decision to use these technologies in a business provides growth and long-term sustainability in a business.

## **Keywords**

Artificial Intelligence (AI)

Cloud Computing

Blockchain

Internet of Things (IoT)

Big Data Analytics

Business strategies

Business efficiency

Strategy optimization

## Οι τεχνολογικές τάσεις και ευκαιρίες στον ψηφιακό κόσμο και η επήρεια τους στην σύγχρονη επιχείρηση

Χαράλαμπος Φούγιας

### Περίληψη

Στη σύγχρονη εποχή με την ραγδαία τεχνολογική πρόοδο, παρουσιάζονται κάποιες άνευ προηγουμένου ευκαιρίες αλλά και προκλήσεις για τις επιχειρήσεις. Σε αυτή τη διατριβή θα διερευνήσουμε το ρόλο των κύριων αναδυόμενων τεχνολογικών τάσεων, όπως η Τεχνητή Νοημοσύνη, η Μηχανική Μάθηση, οι Υπηρεσίες Υπολογιστικού Νέφους, η Αναλυτική Μεγάλων Δεδομένων, το Διαδίκτυο των Πραγμάτων και η Αλυσίδα Μπλοκ στις σύγχρονες επιχειρήσεις αλλά και πώς αυτές οι τεχνολογικές εξελίξεις διαμορφώνουν τις επιχειρηματικές πρακτικές και στρατηγικές. Οι προαναφερθείσες τεχνολογίες είναι αυτές που οδηγούν τον ψηφιακό μετασχηματισμό, αποτελούν αναπόσπαστο κομμάτι για τη βελτίωση της επιχειρησιακής αποτελεσματικότητας, διαδραματίζουν σημαντικό ρόλο στην καινοτομία και παρέχουν ανταγωνιστικό πλεονέκτημα σε αυτούς που τις χρησιμοποιούν με επιτυχία στην σύγχρονη οικονομία η οποία βασίζεται στα δεδομένα.

Αυτή η διατριβή θα εξετάσει το πώς αυτές οι τεχνολογίες επηρεάζουν τις διαδικασίες λήψης αποφάσεων, το πώς παρέχουν καλύτερη συνεργασία και γρήγορη προσαρμογή στις αλλαγές της αγοράς, το πώς παρέχουν καλύτερη πληροφόρηση για την συμπεριφορά των πελατών, πώς βοηθούν στη βελτιστοποίηση της επιχειρηματικής στρατηγικής και πώς παρέχουν διαφάνεια και ασφάλεια σε όλες τις συναλλαγές.

Από την ανάλυση περιπτώσιολογικών μελετών και βιομηχανικών εφαρμογών, η διατριβή αναδεικνύει τον αντίκτυπο που έχουν αυτές οι τεχνολογίες σε διάφορους τομείς, αλλά παρέχει επίσης και μια κριτική άποψη σχετικά με τις προκλήσεις που αντιμετωπίζουν οι επιχειρήσεις με την υιοθέτησή τους. Τα αποτελέσματα της ανάλυσης δείχνουν ότι η στρατηγική απόφαση για χρήση αυτών των τεχνολογιών σε μια επιχείρηση παρέχει ανάπτυξη και μακροπρόθεσμη βιωσιμότητα σε μια επιχείρηση.



## **Λέξεις – Κλειδιά**

Τεχνητή Νοημοσύνη

Υπηρεσίες Υπολογιστικού Νέφους

Αλυσίδα Μπλοκ

Διαδίκτυο των Πραγμάτων

Αναλυτική Μεγάλων Δεδομένων

Επιχειρηματική Στρατηγική

Επιχειρησιακή αποτελεσματικότητα

Βελτιστοποίηση στρατηγικής

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## **List of Abbreviations & Acronyms**

3D = Three Dimensional

AGI = Artificial General Intelligence

AI = Artificial Intelligence

DeFi = Decentralized Finance

EU = European Union

GDPR = General Data Protection Regulation

IaaS = Infrastructure as a Service

INC = Incorporated

IoT = Internet of Things

IT = Information Technology

ML = Machine Learning

NLP = Natural Language Processing

PaaS = Platform as a Service

ROI = Return Of Investment

RPA = Robotic Process Automation

SaaS = Software as a Service

SMEs = Small and Medium-sized Enterprises

UN = United Nations

WCO = World Customs Organization

WTO = World Trade Organization

# 1. Introduction

## 1.1 Background of the Study

The analysis of technology trends and opportunities in the digital world is a critical factor for understanding of how the contemporary businesses, by using them, can function and thrive in a rapidly evolving environment. Emerging and disruptive technologies such as artificial intelligence, machine learning, cloud computing, big data analytics, Internet of Things (IoT), and Blockchain play a key role in reshaping today’s industries by offering powerful tools for a variety of areas such as data analysis, process automation, and transaction security.

### 1.2 1.1.1 Emerging technologies and digital transformation

In the modern environment, the use of digital platforms, e-commerce, and virtual communication has become a necessity for all the businesses that wish to remain competitive. In this context, the digital technologies that are used for the digital transformation of the businesses are a valuable source of competitiveness because they create, capture and deliver value for the business, as well as affect their business models (Bouwdad & Lafraxo, 2024). Moreover, they also present a ROI<sup>1</sup> for the business’s capabilities, since they allow their IT<sup>2</sup> department to focus on more important activities (such as, but not limited to, digitizing existing activities or developing new activities) and leave the non-sensitive IT tasks (Bouwdad & Lafraxo, 2024).

The emerging technologies that we will focus on this dissertation are the AI and ML (that enhance decision-making, improve customer experience, enhance security and transparency and foster innovation), the Big Data Analytics (that enhance decision-making and provide agility and scalability), Cloud Computing (that increase efficiency and productivity, bring cost reduction and provide agility and scalability), IoT (that increase efficiency and productivity, improve customer experience, foster innovation and promote sustainability and social responsibility) and Blockchain (that brings cost reduction, enhances security and transparency, promotes sustainability and social responsibility). The successful adoption of the above technologies by businesses, especially at an early stage, often gives them the first

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<sup>1</sup> ROI = Return Of Investment

<sup>2</sup> IT = Information Technology

mover advantage, positions them as industry leaders and innovators and consequently gives them a competitive advantage.

### **1.3 Problem statement**

#### **1.3.1 Research Question**

The question we primarily base our study is the following:

"What is the role of the main emerging technological trends in the contemporary business and how those technological advancements shape business practices and strategies?"

The purpose of this study is to examine the significance of the role of AI and ML, Big Data Analytics, Cloud Computing, IoT and Blockchain in modern businesses and the benefits and challenges inherent to adopting and using these technologies.

We also want to explore how those technologies influence their growth, efficiency and effectiveness as well as the reduction of cost. Additionally we will identify the challenges that businesses face when adopting and implementing such technologies.

In order to provide a better understanding of the research question, as well as to provide the necessary consistency and depth in this study regarding the role of AI and ML, Big Data Analytics, Cloud Computing, IoT and Blockchain in modern businesses, we decided to further breakdown the research question into four sub-questions.

In this way we facilitate our research better, since that by dividing the main research question into sub-questions we can focus to specific areas of the research at a time, we can ensure that all aspects are equally addressed and we can perform a more targeted analysis.

The research question breakdown is the following:

- What are the characteristics of AI and ML, Big Data Analytics, Cloud Computing, IoT and Blockchain that provide benefit to businesses?
- What are the benefits for businesses that adopt AI and ML, Big Data Analytics, Cloud Computing, IoT and Blockchain into their operations?
- What challenges face businesses that adopt AI and ML, Big Data Analytics, Cloud Computing, IoT and Blockchain into their operations?
- How the adoption of AI and ML, Big Data Analytics, Cloud Computing, IoT and Blockchain into a business shapes its practices and strategies?



The table that shows the research question breakdown, along with the objectives and goals of each sub-question, is the following:

Main Research Question	What is the role of the main emerging technological trends in the contemporary business and how those technological advancements shape business practices and strategies?
Sub-question 1	What are the characteristics of AI and ML, Big Data Analytics, Cloud Computing, IoT and Blockchain that provide benefit in businesses?
Objective	Research the literature to find the useful characteristics of these technologies.
Goal	Determine how those characteristics may influence the business practices and strategies.
Sub-question 2	What are the benefits for businesses that adopt AI and ML, Big Data Analytics, Cloud Computing, IoT and Blockchain into their operations?
Objective	Research the literature in order to find the benefits of using those technologies.
Goal	Determine the impact to the business operations by using these technologies.
Sub-question 3	What challenges face businesses that adopt AI and ML, Big Data Analytics, Cloud Computing, IoT and Blockchain into their operations?
Objective	Review the literature to understand the challenges businesses face when implementing those technologies.
Goal	Provide an overview of the usage of those technologies in businesses including the potential advancements along with the challenges during implementation.
Sub-question 4	How the adoption of AI and ML, Big Data Analytics, Cloud Computing, IoT and Blockchain into a business shapes its practices and strategies?
Objective	Assess the growth, efficiency, effectiveness and the cost reduction that the businesses achieve by implementing those technologies.
Goal	Provide insights and recommendations for businesses willing to use such technologies.

**Table 1 – Research Question Breakdown**

### 1.3.2 Objectives of the Study

The study objectives are formed in a way to investigate progressively and comprehensively the application of the modern digital technologies such as AI and ML, Big Data Analytics, Cloud Computing, IoT and Blockchain and how those are influencing the business. Specifically there is going to be a research / review of the literature having the following objectives:

- As first objective to find the useful characteristics of these technologies.
- As second objective to find the benefits of using those technologies.
- As third objective to understand the challenges businesses face when implementing those technologies.
- As fourth objective to assess the growth, efficiency, effectiveness and the cost reduction that the businesses achieve by implementing those technologies.

### **1.3.3 Goals of the Study**

This study has four goals that aim to examine the significance of the role of AI and ML, Big Data Analytics, Cloud Computing, IoT and Blockchain in modern businesses and the benefits and challenges for the businesses that adopt and use these technologies. Analytically:

- The first goal is to determine how the useful characteristics of AI and ML, Big Data Analytics, Cloud Computing, IoT and Blockchain may influence the business practices and strategies.
- The second goal is to determine the impact of AI and ML, Big Data Analytics, Cloud Computing, IoT and Blockchain to the business operations.
- The third goal is to provide a usage overview of AI and ML, Big Data Analytics, Cloud Computing, IoT and Blockchain for businesses including benefits and challenges.
- The fourth and final goal is to provide insights and recommendations for businesses willing to use such technologies.

## **1.4 Significance of the Study**

The analysis of technology trends and opportunities in the digital world is a critical factor for understanding of how the contemporary businesses that are using them can function and thrive in a rapidly evolving environment. Emerging and disruptive technologies such as Artificial Intelligence, Machine Learning, Cloud Computing, Big Data Analytics, Internet of Things (IoT) and Blockchain play a key role in reshaping today's industries by offering powerful tools for a variety of areas such as data analysis, process automation, and transaction security. In the modern environment, the use of digital platforms, e-commerce, and virtual communication has become a necessity for all the businesses that wish to remain competitive.

Taking into account the above, this topic has a particular importance, particularly because these technology trends push all the innovation and improvements in business operational efficiency, customer engagement, and decision-making. For example, the use of AI in data analytics helps firms in strategic decisions and the cloud applications helps with cost reduction, scalability and redundancy. Of course, in this journey for innovation a business not only has opportunities but also faces challenges, such as cybersecurity issues and the lack of digitally literate employees.

The usefulness of this analysis is based on the fact that in order for a company to leverage technology effectively, in order to achieve growth, promote innovation and be relevant; it has to know the potential as well as the shortfalls of each technology trend.

## **1.5 Structure of the Thesis**

The dissertation is organized in six chapters as follows:

- Chapter 1 is the Introduction to the study where the background of the study, the problem statement, the significance of the study and the study structure are analyzed.
- Chapter 2 is the Literature Review where there is an overview of the technology trends, a presentation of the major technological Trends (Artificial Intelligence and Machine Learning, Big Data Analytics, Cloud Computing, Internet of Things and Blockchain etc.) and a summary of the key insights related to the key technological trends.
- Chapter 3 is the Analysis of the Key Technology Trends and specifically Artificial Intelligence and Machine Learning, Big Data Analytics, Cloud Computing, Internet of Things and Blockchain.
- Chapter 4 is the Opportunities and Challenges for the Contemporary Business, the data-driven decision-making, the digital transformation, the remote work and virtual collaboration and the workforce adaptation.
- Chapter 5 is the Case Studies and Industry Applications.
- Chapter 6 is the Conclusions and Recommendations.

## 2. Literature Review

One of the most common definitions of technology is *“Technology is the way that scientific knowledge evolves in the production of goods and services or in achieving goals using tools and techniques to achieve outcomes”* (Skilton & Hovsepian, 2018) . The origin and etymology of the term “technology” comes from the Greek language (word τεχνολογία) and comprises of the term “techno” which originates from the Ancient Greek word «τέχνη» which means art or craft and the term “logy” which comes from the Ancient Greek word «λογία» which means a subject of study (Lancaster, 2021) .

The speed of new technology development has been increasing in recent years and those technologies not only change our everyday life but also change how businesses function and operate. The evolution of technology through the successive industrial revolutions has transformed industry, economy, businesses, society and ultimately the human civilization. It all started with the first Industrial revolution (late 18<sup>th</sup> to early 19<sup>th</sup> Century) which was marked by the invention of the steam engine (1781 by Watt) because it made possible the production of mechanical energy from thermal energy on demand and had as primary energy source the coal. This caused the transformation of societies from agrarian to industrial (Skilton & Hovsepian, 2018) (Wikipedia, 1st Industrial Revolution, 2025).

It continued with the second Industrial Revolution or Technological Revolution (late 19<sup>th</sup> to early 20<sup>th</sup> Century) which introduced the electric motor, the large-scale industrial electrification, internal combustion engines, mass production and many advancements in chemistry and communications. This era brought new industries to the foreground and provide the basis for the globalization of the economy (Skilton & Hovsepian, 2018) (Wikipedia, 2nd Industrial Revolution, 2025).

The third Industrial Revolution or Information Age or Digital Revolution (mid 20<sup>th</sup> to present) introduced the transistor, the microelectronics, the semi-conductors, the integrated circuits and the computers and marked a transition from the traditional industries that were based to mechanical and analog technology, to the digital industries focused on information technology. During this era the speed of technology evolution has been increased in a geometric rhythm compared to the previous industrial revolutions leading to technological breakthroughs such as AI and ML, Big Data Analytics, Cloud Computing, IoT, Blockchain and others, marking the dawn of the fourth Industrial Revolution (early 21<sup>st</sup> Century to

present). Expert’s opinions differ on whether the third Industrial Revolution has ended and the fourth Industrial Revolution has emerged due to the dawn of those breakthrough technologies (Skilton & Hovsepian, 2018) (Wikipedia, Information Age, 2025).

## **2.1 Overview of Technology Trends**

In this fourth Industrial Revolution, humanity has experienced the dawn of various technologies that can be characterized as disruptive which according to the Cambridge Dictionary means *“technologies that change the traditional way that an industry operates, especially in a new and effective way”* (CambridgeDictionary, 2025). The term “Disruptive” may be heard as negative or confusing but in fact, we are talking about the evolution of technology that changes the way we do things or the way we do business (WCO & WTO, 2022)<sup>3</sup>.

In the modern era, a series of new technologies and innovations that leverage the increased connectivity and bandwidth of telecommunications, the increased processing and computational power, the digitization of all information (current and past) and the lowering of the respective costs, influence greatly how we do things and how we contact our businesses (WCO & WTO, 2022).

However, why is so important for a business to adopt one or more of those technologies to its everyday operations? By staying up to date in the applicable technologies in a business sector, a business can find new solutions to old problems, can be relevant and can be one (or more) steps ahead of the competition. Furthermore, a business can improve efficiency and productivity, can streamline its operations and ultimately deliver more value to its customers. Not only that, but also it can create new opportunities; it can expand into new markets, reinvent its products and / or services as well as redefine an industry (and industry standards). In this way, businesses achieve sustainment and can become the leaders of their sector (Business Models INC, 2025).

According to Skilton & Hovsepian, among the technologies that will reshape the form of businesses today and tomorrow are the Cloud Computing and Multisided Platforms, the Machine Learning and Artificial Intelligence, the Internet of Things, Micro-Electro-Mechanics and Bio Sensor Tech, Robotics, the Virtual Reality, Augmented Reality, Mixed

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<sup>3</sup> WCO=World Customs Organization, WTO=World Trade Organization

Reality and 3D Printing, Additive Manufacturing and Near Net Shape Manufacturing, the Quantum Computing, Nanotechnology and Biochips and the Blockchain (Skilton & Hovsepian, 2018), whereas according to Business Models Inc. those are Generative Artificial Intelligence, Cloud Computing, Immersive technologies (Augmented Reality, Virtual Reality and Mixed Reality), Blockchain, Internet of Things, Machine Learning, Robotic Process Automation, Humanoid Robots, Artificial General Intelligence and Nanotechnology (Business Models INC, 2025).

In this study we will examine the effect of Artificial Intelligence and Machine Learning, Big Data Analytics, Cloud Computing, Internet of Things and Blockchain to the contemporary businesses, how they shape business practices and strategies, how they are influencing the decision making processes, how they provide better collaboration and quick adaptation to market changes, how they provide better understanding of the customer behavior, how they help optimizing business strategy and how they provide transparency and security in all transactions.

## **2.2 Major Technological Trends**

### **2.2.1 Artificial Intelligence (AI) and Machine Learning (ML)**

John McCarthy, who invented the term AI, stated during a debate of AI researchers organized by James Lighthill on 9<sup>th</sup> of May 1973 that *"AI is the study of problem solving and goal achieving processes in complex situations"* (The Lighthill Debate (1973) part 3 of 6, 2025) (Lighthill report, 2025), whereas in one of his more recent papers, where he provides answers to question regarding AI for non-experts, he stated that *"AI is the science and engineering of making intelligent machines, especially intelligent computer programs. It is related to the similar task of using computers to understand human intelligence, but AI does not have to confine itself to methods that are biologically observable"* (McCarthy, 2007). Another definition that can be extracted by looking at scholar articles regarding AI is that *"AI is the art of creating machines that perform functions that require intelligence when performed by people"* (Emmert-Streib, Yli-Harja, & Dehmer, 2020) or *"AI is the capability of machines to imitate intelligent human behavior. This may involve performing various cognitive tasks, such as sensing, processing oral language, reasoning, learning, making decisions, and demonstrating an ability to manipulate objects accordingly"* (UN, 2017).

So, to our understanding and by taking into account the above, AI is a technology that entails the development of systems and machines that are capable of emulating human-like behavior and intelligence when performing tasks such as solving problems, communicating and interacting.

We put AI and ML together as most companies that use AI today they simultaneously use ML. That happens so much, that both terms are often used interchangeably, which is not exactly the case. ML, in reality, is a sub-field of AI, which develops algorithms that enable machines to imitate intelligent human behavior. ML is doing that by enabling machines to analyze big amounts of data, learn from those data and make decisions based on those data without being explicitly programmed (Brown, 2021).

The main characteristics of AI is the **Symbolic Processing**, where its algorithms focus on symbols rather than numbers or letters; they transform objects, events and environments to strings, then to symbols and then organize those into lists or hierarchies, then it finds the relationship between those symbols. AI is **Non-Algorithmic**, in contradiction with traditional programs, which use specific algorithms that require specific instructions by the user; AI is working autonomously towards problem solving providing great adaptability. AI has also **Reasoning**, as AI is working with knowledge rather than data, by using algorithms such as case-based reasoning, case-based decisions, and analogical reasoning and in this way mimics the human cognitive process. AI provides great **Data Ingestion**, as by using ML and statistical algorithms is capable of managing huge and diverse datasets eliminating human errors, maximizing accuracy accelerating processing and increasing efficiency in the whole process. AI has human like **learning ability**, which is achieved through AI models that emulate human ability to learn from experience and training. Finally AI has **Imprecise knowledge**, which is achieved by using algorithms that leverage fuzzy logic, formal logic and mathematic morphology, and in contradiction with the classic applications, are excellent in using unstructured and imprecise information and are perfect in for real-world applications (Bhumichai, Smiliotopoulos, Benton, Kambourakis, & Damopoulos, 2024).



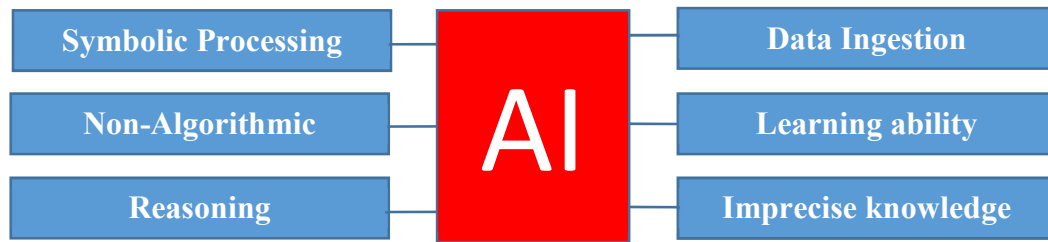


Figure 1: Characteristics of AI

ML, which is often confused with AI, is actually a subset of AI, which focuses on developing the algorithms that the AI systems use to improve their cognitive tasks, such as object detection and natural language translation without explicit programming. Those algorithms are using iteratively problem-specific data to train themselves to perform those tasks (Janiesch, Zschech, & Heinrich, 2021).

The main characteristics of ML are the **Data-Driven Learning**, where ML systems in order to identify patterns and make decisions have to work with large datasets where factors such as quality and quantity of data greatly influence the performance; **Generalization**, which is the ability to perform well on unseen data other than the training dataset and thus making the model suitable for real-world applications; **Adaptability**, which is the capability to adapt to new data and improve knowledge and performance as more information becomes available; **Automatic Feature Extraction**, which is the ability to identify and extract relevant features from raw data and handling complex data types (such as images or text) without human intervention; **Model Evaluation and Validation**, which is the assessment of the ML models to evaluate its reliability and robustness and **Scalability** which is the ability to be able to handle large volume of data and perform complex computations.

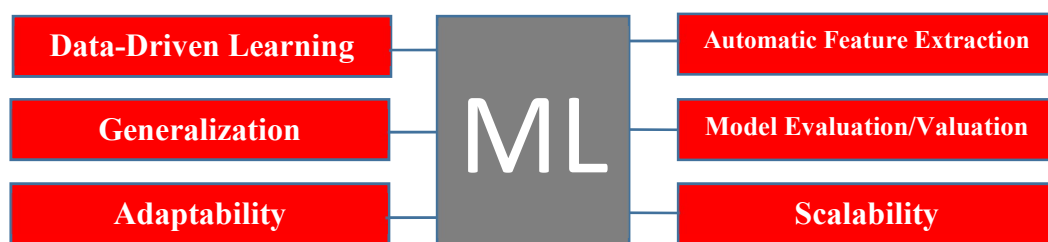


Figure 2: Characteristics of ML



### 2.2.2 Big Data Analytics

Big data analytics, or else known as big data, *“is the systematic processing and analysis of large and complex amounts of data or data sets in order to extract valuable insights”*. With the big data analytics, we can find trends, patterns and correlations in large amounts of raw data to help analysts making data-informed decisions (Mucci & Stryker, 2024). Big data can also be defined as *“an information asset with high volume, velocity, and variety, which requires specific technology and method for its transformation into value”* (Batko & Ślęzak, 2022) or as *“the often-complex process of analyzing large amounts of data to identify information such as hidden patterns, correlations, market trends, and customer preferences that can assist businesses in making better decisions”* (Smaya, 2022) or as *“a process to analyze the large data volumes to capture value for the businesses and employees”* (Sabharwal & Miah, 2021).

Big data sets are very important because they are used for a variety of business reasons, such as marketing, stock level, employment etc. and help businesses to make better decisions in order to increase their profits. Many researchers dealing with Big Data mostly refer to the Vs of Big data, which are their major characteristics. Initially, they referred to the 3 Vs which are the **Volume** which refers to the large size of the data that is continuously growing; **Velocity** which refers to the need of speedy data analysis in order to get the required information (even in real time) so as to make informed decisions and **Variety** which refers to the diversification of the data not only due to their sources and their type but also due to their structure.

Due to the rapid technological development in the recent years and the increased possibility that data can be unreliable due to bias, noise, obsolescence or errors and thus misleading, a fourth characteristic was introduced; **Veracity**, which refers to the credibility, trustworthiness and quality of the data that is also of great significance as important decisions depending on those data. Nguyen on the other hand, after revisiting the four above Vs, introduced a fifth one, **Value**, that refers to the translation of those data to actual value for the businesses, which may be social or economic, but in any case, at the end, this value is translated to monetary income. Then scholars introduced another two Vs, **Validity** which refers to the data accuracy with respect to their intended use (somebody may confuse it with Veracity but could be a case where data have veracity but are not valid for the intended scope) and **Volatility**, which refers to the lifespan of the data, as in many cases data in order

to be of value have to be current. Finally Ranjan added another three Vs, increasing the total number to ten, that is **Variability**, which may be confused with Variety but actually refers to the inconsistency and fluctuations of data flows over time and requires to apply anomaly and outlier detection methods, **Visualization**, which refers to the presentation of data mostly in graphical format that makes it easier for the decision makers to understand and interpret them and **Vulnerability** which has to do with the security risks and compliance to regulations (such as GDPR<sup>4</sup> for example) associated with storing, managing and processing large volumes of data (Rashid & Chaturvedi, 2019) (Sun, Strang, & Li, 2018).

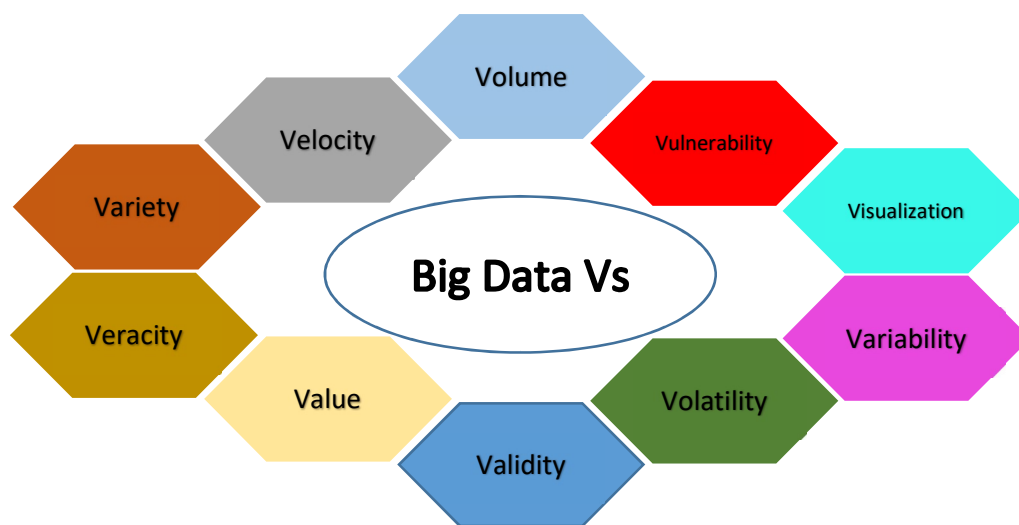


Figure 3: The Characteristics of Big Data (the 10 Vs of Big Data)

### 2.2.3 Cloud Computing

According to Vaquero et al, “Clouds are a large pool of easily usable and accessible virtualized resources (such as hardware, development platforms and/or services). These resources can be dynamically reconfigured to adjust to a variable load (scale), allowing also for an optimum resource utilization. This pool of resources is typically exploited by a pay-per-use model in which guarantees are offered by the Infrastructure Provider by means of customized Service-Level Agreements” (Vaquero, Roderio-Merino, Caceres, & Lindner, 2009). Another definition for Cloud Computing is “It is the delivery of computing resources and services, such as storing of data on servers and databases, providing networking facilities and software development platforms over the Internet” (Mishra & Panda, 2019). In addition, a more simple terms definition is “Cloud computing means storing and

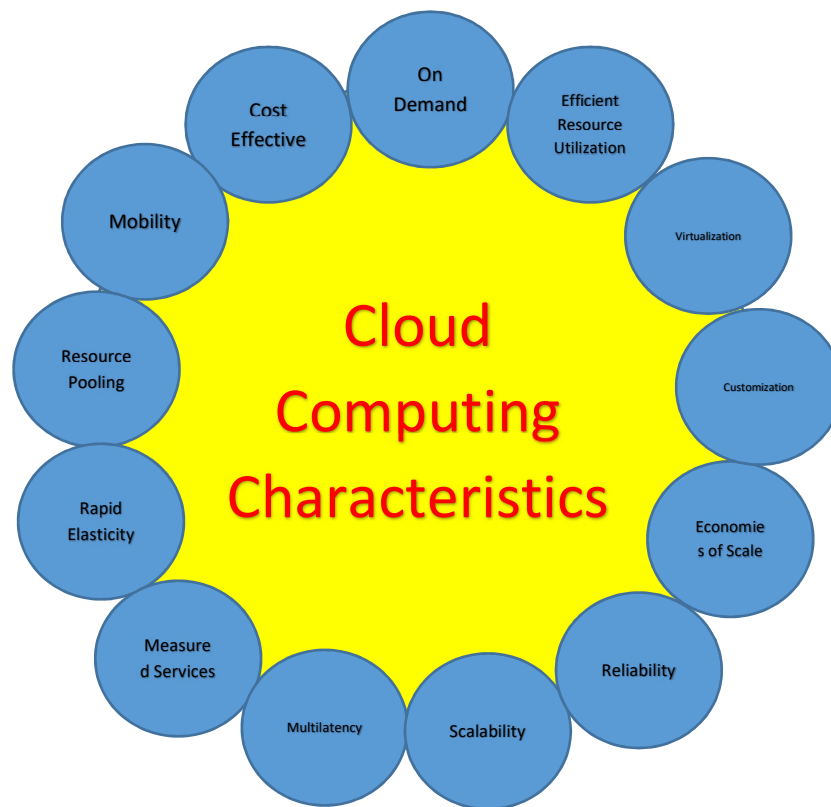
<sup>4</sup> GDPR = General Data Protection Regulation

*accessing data and programs over the Internet instead of our computer's hard drive, where cloud is just a metaphor for the Internet. With cloud computing, users can access files and use applications from any device that can access the Internet"* (Rashid & Chaturvedi, 2019).

In practice Cloud computing is a service, it provides an on-demand access to a shared pool of computing resources over the internet that are also configurable according to the needs of the customer and the specific application. It is rather a system that is comprised of three services: infrastructure as a service (IaaS), software as a service (SaaS) and platform as a service (PaaS) (Rashid & Chaturvedi, 2019).

The key characteristics of Cloud Computing is that they are an **On-demand self-service** which is allocated automatically as required by the specific application and function that the customer uses, they are **Cost effective** because apart from the fact that you do not need to purchase any infrastructure, skipping all associated costs (setup cost, maintenance etc.) have a pay per usage billing model (if not provided free e.g. Gmail), they provide **Broad Network Access (mobility)** since customers can access it anywhere, anytime from various types of devices, they have a **Resource Pooling** where a lot of customers share the same resources and they do not have control or knowledge of their location, they have **Rapid Elasticity** since the resources are provided based on the customer demand and the customers see those resources as if they are infinite and they are **Measured Services** since they have a pay per use model which is very similar to utilities (Rashid & Chaturvedi, 2019).

Other characteristics are the **Multitenancy**, which is the simultaneous use of the resources by many users that are isolated in their customized virtual application, the **Scalability**, which is the capability to add new nodes and servers with minimal modifications to the cloud, the **Reliability**, which is achieved by the node, server and site redundancy and makes it perfect for disaster recovery and critical business tasks, the **Economies of Scale** which leverage the principles of "the more / bigger the cheaper" and of decentralization where providers deploy large scale infrastructure close to cheap power stations and on low cost real estate, the **Customization** since cloud can be adjusted and reconfigured based on customer demand, the **Efficient Utilization of Resources** since they are on demand basis and **Virtualization** which is a process that allows the sharing of the hardware resources with multiple digitally separated environments (Rashid & Chaturvedi, 2019).



**Figure 4: The Characteristics of Cloud Computing**

#### **2.2.4 Internet of Things**

There is a variety of definitions that describe the Internet of Things, some synonymous, some that having similar meaning but some that have a very broad range of interpretation. In general, there are three common characteristics of the IoT definitions: they tend to be too abstract, they involve tautologies<sup>5</sup> and they are usually products of their time, so as time goes by and technology evolves so do the definitions of IoT and in this way inconsistencies between definitions exist (Goumagias, Whalley, Dilaver, & Cunningham, 2021).

In the Internet of Things era, various devices (things) are connected to the Internet and with each other. Those devices form a heterogeneous set, which ranges from consumer devices such as cellphones, wearables, laptops, and home appliances to industrial sensors, actuators and robots. IoT means different things to different people and has no universal definition. In general it has two different perspectives, the technical (in which is regarded as an ecosystem of technical artefacts and is defined by their technical capabilities) and the socio-

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<sup>5</sup> the use of different word to say the same thing twice in the same sentence

technical (where apart from the technical artefacts and their capabilities, reference is also made to the respective actors that interact within it) (Lynn, Mooney, Lee, & Endo, 2020).

A characteristic definition for IoT with a technical perspective is: *“IoT is a global network and service infrastructure of variable density and connectivity with self-configuring capabilities based on standard and interoperable protocols and formats [which] consists of hetero-generous things that have identities, physical and virtual attributes, and are seamlessly and securely integrated into the Internet”* and its short version is: *“IoT is a dynamic global network and service infrastructure of variable density and connectivity enabling services by interconnecting things”* (Tarkoma & Katasonov, 2011).

Whereas, a characteristic definition for IoT with a socio-technical perspective is *“A world where physical objects are seamlessly integrated into the information network, and where the physical objects can become active participants in business processes. Services are available to interact with these ‘smart objects’ over the Internet, query their state and any information associated with them, taking into account security and privacy issues”* (Haller, Karnouskos, & Schroth, 2009).

The key characteristics of the IoT are the **Connectivity**, which is accomplished through the internet offering smooth communication and data transfer among various types of devices, the **Intelligent Decision Making** which is a matter of transforming the data collected to a meaningful info and make informed decisions, the **Dynamic Self Adapting** according to the environment and the circumstances, **Scalability**, which is the capability to handle the ever increasing number of “things” connected to the network as well as the respective data volume increment, the **Unique Identity**, which is essential to properly identify the devices (also for security reasons), the **Self-Configuring**, which requires no intervention from the user and provides flexibility in the network management, the **Interoperability**, which permits various different (with respect to type, protocol, technology or manufacturer) device to interact and exchange data smoothly, **Heterogeneity**, which is the capability of interconnecting a various array of devices, the **Energy Efficiency**, which is an inherent characteristic of IoT devices that are especially made to minimize / optimize power usage and **Security** which is of great importance as millions of devices are connected and huge amount of data are generated (Ali, et al., 2022), (Ananna & Saifuzzaman, 2024). These characteristics of IoT makes possible the integration of physical and digital worlds and helps the development of innovative applications across various sectors of the economy.

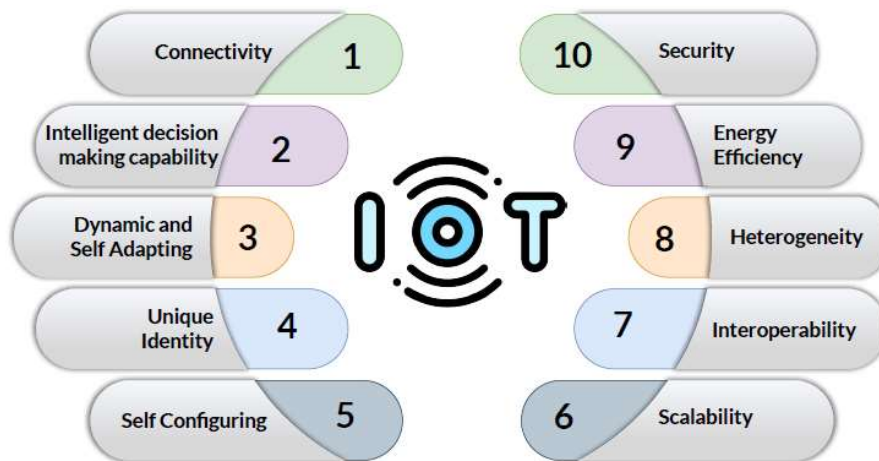


Figure 5: The Characteristics of IoT (Ananna & Saifuzzaman, 2024)

### 2.2.5 Blockchain

According to Ghosh “Blockchain is a chain of blocks that contains a complete record of transactions that may be publicly or privately distributed to all users of the chain, hence be decentralized” (Ghosh, 2019), whereas, according to a definition found in Chen et al., “Blockchain technology which is also known as distributed ledger technology, allows participants to secure the settlement of transactions, achieve the transaction, and transfer of assets at a low-cost” (Chen, Xu, Lu, & Chen, 2018), finally according to An et al. “Blockchain serves as an immutable distributed ledger technology which allows transactions to be carried out credibly in a decentralized environment, it is essentially a distributed public ledger with the nature of a key-value database, and all transaction data is permanently recorded in a one-way chain list through asymmetric encryption technology and distributed consensus technology” (An, Fan, Yu, Zhao, & Haiyang, 2023).

Blockchain has a **decentralized distributed** structure, which means that each node has a peer-to-peer relationship with the other nodes. All nodes can collect transactions and record them into blocks that form a block chain which is stored in each node, so all nodes have the same info and do **not need to trust the other nodes** (An, Fan, Yu, Zhao, & Haiyang, 2023).

The distributed system structure is the basis for the verification, accounting, storage, maintenance and transmission of transactions in the Blockchain. The main idea is that **instead of using third parties** (as banks and financial institutions) to build the trust in the transactions, we create a decentralized and trusted distributed system (Blockchain). All



nodes participate, maintain the Blockchain and are part of the verification process of the block. The **stability** and **security** is established by the consensus mechanism that selects in which specific node of the Blockchain the new block will be added (An, Fan, Yu, Zhao, & Haiyang, 2023).

The chain structure has **time stamps**, so all **transactions can be traced and thus audited**. The Blockchain is built in a way that each block has the info of the previous block, as such, each block has the info of all the previous blocks, so if you attack a block in order to tamper its info, you have to do the same will all the following blocks and that has to happen within a limited timeframe. This attack needs a lot of processing power (more than half of the one needed by the Blockchain), which means a huge price for the attacker. Apart for that the data are also **asymmetrically encrypted** and special complex consensus algorithms are used, so the data on the Blockchain are secure, have high **credibility** and **confidentiality** and are **immutable** (An, Fan, Yu, Zhao, & Haiyang, 2023).

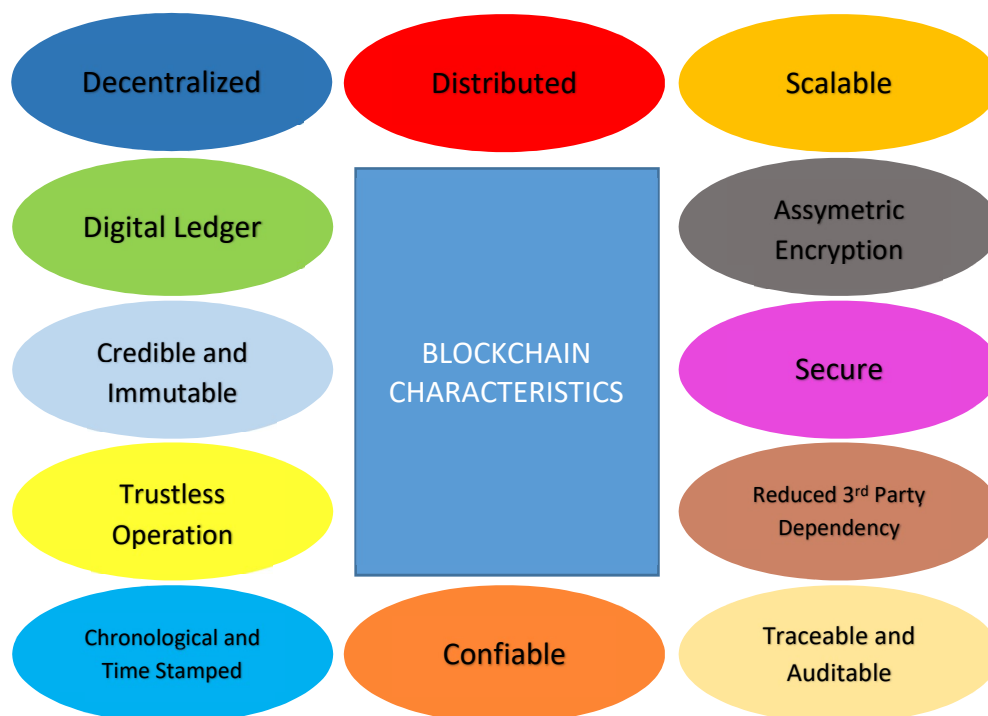


Figure 6: The Characteristics of Blockchain

## 2.3 Summary of Key Insights

**AI** focuses on developing machines that can emulate human-like behavior and intelligence in order to perform tasks such as problem solving, communication, and interaction. Key

characteristics of AI is that it does symbolic processing, it is non-algorithmic, it has reasoning, it provides great data ingestion, it has human-like learning abilities and it provides an imprecise knowledge handling. ML, which is a subset of AI, develops the algorithms that power most of AI's capabilities. Its main characteristics is the data-driven learning, the generalization with new data, the adaptability to evolving information, the automatic extraction of features from raw data and the robustness through model evaluation, validation and scalability in order to process vast datasets.

**Big data analytics** is the systematic processing and analysis of large and complex datasets with the ultimate goal to improve the decision-making. Its main characteristics are Volume, Velocity, Variety, Veracity, Value, Validity, Volatility, Variability, Visualization and Vulnerability namely the 10 Vs.

**Cloud computing** in plain words, is the provision of computing resources and services (such as data storage, networking, and software development platforms) over the Internet and in this way make it accessible everywhere from any internet-connected device. Key characteristics are the on-demand self-service, the cost-effectiveness, and the mobility, the pooling of resources among users, the rapid elasticity and the pay-per-use model. Other important characteristics are the multitenancy, the scalability, the reliability, the economies of scale, the decentralization, the customization, its efficient resource utilization and the virtualization.

**IoT** is the interconnection of various types of devices through the internet that enables data exchange and communication. Its key characteristics include connectivity, intelligent decision-making, dynamic self-adaptation to environmental changes, scalability, unique device identity, self-configuration without user intervention, interoperability among diverse systems, the heterogeneity in device types, the energy efficiency and the robust security.

**Blockchain** is a decentralized, distributed ledger (chain of blocks that contain the complete transactions records) which is secure, immutable, and transparent and eliminates the need for intermediaries. Its characteristics are the decentralized distributed structure, the no need to trust the other nodes, the no need for intermediaries, stability, security, integrity, confidentiality, immutability, traceability and auditability.



### 3. Analysis of the Key Technology Trends

In this chapter, we will perform the analysis of the key technology trends (AI, ML, Blockchain, IoT, Big Data Analytics, and Cloud Computing). This analysis will reveal the dynamic landscape where these technologies are increasingly interlinked and drive the innovation across various sectors. These technologies are not only transforming the way businesses and industries function, but they also reshape societal structures with the introduction of smarter and more efficient systems. The convergence of these technologies is decisive in addressing contemporary challenges and unlocking new opportunities for growth and development.

#### 3.1 Artificial Intelligence and Machine Learning

The introduction of the AI brought a new way of transforming business strategies and operations as well as customer engagement. With the integration of AI into the various business processes, businesses have the opportunity to enhance their efficiency, to introduce innovation and thus gain a competitive advantage against their competitors. Bellow we will explore how AI influences businesses and we will especially focus on its applications, its challenges and its potential.

By introducing AI technology into businesses, such as ML and RPA<sup>6</sup>, especially for the automation of routine tasks (for example: copy and paste data, move files and folders, process data by following logical rules, making calculations, extract data from documents, fill out forms, or merge data from multiple sources) a business can streamline workflows and in this way permit its employees to focus on more strategic or important activities. Therefore, AI is contributing into the **enhancement of productivity and efficiency**. Furthermore, with the introduction of AI and RPA, companies such as Automation Anywhere and Blue Prism, **reduced the operational cost** and **improved employee satisfaction** (Business Models INC, 2025).

Other examples of improvements in businesses that used AI, is the feature of AI-driven personalization in platforms such as Spotify or Netflix, where AI is used to predict user preferences (based on past search and view history and behavior) and in this way enhancing

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<sup>6</sup> RPA= Robotic Process Automation

customer experience. Other example is the use of Generative AI<sup>7</sup>, which helps companies to automate the creation of various types of content (text, photo, video, etc.) and in this way provides personalized customer experiences at scale and opens new horizons in the development of new services. In this way, AI contributes in the **personalization and customer engagement** (Business Models INC, 2025).

AI has also the capability of predictive analysis. Using this feature, businesses can forecast future trends and opportunities and in this way can contribute in the strategic decision-making. The advanced analytics of AI that includes data mining<sup>8</sup> and deep learning<sup>9</sup> can help to uncover patterns and relationships among huge data sets and in this way provides the basis for businesses to make informed decisions. Therefore, AI can contribute to **Decision-Making and Strategic Planning** (Mucci & Stryker, 2024).

In the use of AI by businesses, there are not only benefits but also challenges and considerations that need to be tackled. The most important of those is the transparency and the potential for bias in AI systems, which can affect user trust and privacy. Those **ethical and privacy concerns** are addressed by some countries with the provision of specific binding ethical guidelines (as EU did with the European AI Act) (Zúñiga, Goyanes, & Durotoye, 2024). Another consideration is that the introduction of AI into a business often requires significant changes in the business structures and / or processes. Businesses have to adapt their structures and processes in order to effectively introduce and exploit AI into their business model (Bouwdad & Lafraxo, 2024). Therefore, **integration and adaptation** is also a challenge for businesses in their effort to use AI in their business models.

As far as the future of AI in businesses is concerned, that includes **Emerging Technologies and Innovations** such as the development of AGI<sup>10</sup>, which aims to create systems capable of understanding and learning across various tasks that potentially exceed human intelligence and be used in creating smart cities, enhancing urban planning and revolutionize societal infrastructure (Zúñiga, Goyanes, & Durotoye, 2024).

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<sup>7</sup> Generative AI= A subset of AI that uses generative models to produce text, images, videos, or other forms of data.

<sup>8</sup> AI Data Mining = Using AI techniques such as deep learning and neural networks to mine vast amounts of structured and unstructured big data more intelligently and efficiently than manual or traditional methods would allow.

<sup>9</sup> Deep Learning = A type of machine learning that uses artificial neural networks to learn from data.

<sup>10</sup> AGI = Artificial General Intelligence, in contrast with narrow AI which is limited to specific tasks, is a type of AI that matches or surpasses human cognitive capabilities across a wide range of cognitive tasks.

It is apparent that AI can make a huge difference in how modern businesses work and function, especially in enhancing the productivity and efficiency, reducing the operational cost, improving employee satisfaction, improving personalization and customer engagement, and improving the decision-making and the strategic planning. But as most things there are also ethical and privacy concerns as well as challenges with the integration and adaptation by business that need to be addressed in order for AI to reach its full potential within businesses. Future advancements in AI technologies promise to revolutionize further business operations and societal infrastructure.

### 3.2 Big Data Analytics

Big Data Analytics has become an important and transformative tool for various sectors, as it has permitted them to work with huge amounts of data improving their operational efficiency and strategic decision-making. By integrating the Big Data analytics into their practices, businesses, not only improve their decision-making processes but also innovate and build a competitive advantage.

Big Data Analytics are providing significant benefits such as the **real-time intelligence** where organizations are now able to analyze huge amounts of data the time they are generated and thus enable them to have a fast decision-making and consequently an almost immediate response to market changes (Mucci & Stryker, 2024). Other benefits are the **cost savings** which are implemented by the identification of the various inefficiencies which then can be optimized leading to the reduction of the operational costs (Mucci & Stryker, 2024) (Smaya, 2022) and the **enhanced decision-making** which is accomplished by the capability to get a deeper insight into the trends and the patterns that improve the operational efficiency and the strategic planning (Mucci & Stryker, 2024) (Sabharwal & Miah, 2021). Especially in finance applications, Big Data Analytics, by integrating diverse data sources, **enhance predictive modeling**, and in this way allowing the institutions to anticipate risks and market trends (Olaiya, et al., 2024). In healthcare, it provides **operational efficiency** by optimizing the allocation of resources, by doing better disease predictions and by making treatments more personalized and thus improving patient care (Tripathi & Rout, 2024). Finally, it can identify **new trends and innovations** enhancing service delivery in various sectors not only in business but also in government as well (Sawitri, 2024).

Of course Big Data Analytics do not have only benefits but also have concerns such as **security and data protection** which is an inherent feature of the large data systems that have unique security challenges such as the **data quality and accessibility**, because ensuring the data integrity and managing the huge volume of data is resource-intensive (Smaya, 2022) and the **data integration**, because the scattered data across systems and in various setups may hide the total view and complicate the decision-making (Olaiya, et al., 2024).

Summarizing, Big Data Analytics can greatly influence the way modern businesses work and function as they provide real-time intelligence, cost savings, enhanced decision-making, enhance predictive modeling, operational efficiency and definition of new trends and innovations. Of course, Big Data does not come without concerns about security and data protection, about data quality and accessibility and concerns regarding data integration.

### 3.3 Cloud Computing

The use of cloud computing has brought to companies and organizations a new way of accessing and managing IT resources that offered significant benefits. The most important one that has an immediate effect on companies balance sheet is the **cost efficiency** since, a company, by using cloud computing services reduces the need of expensive investments in hardware and software as well as maintenance cost, paying only for what they use (Mishra & Panda, 2019). Companies also reduce their operational cost, as necessary functions such as maintenance and upgrades are now managed by cloud service providers. By doing so, companies can convert their fixed costs into variable costs and in this way they pay only for the resources they consume (Attaran, 2017).

Cloud Computing also allows companies to easily enlarge or shrink their capabilities without the need to pay all that up-front cost of the investment to equipment, so **scalability** is also an inherent benefit of cloud computing (Rashid & Chaturvedi, 2019).

Another feature of cloud computing is that it provides an on-demand access to computing resources from all over the world with the only prerequisite to have an internet connectivity, which now with the development of satellite internet is pretty much accessible anywhere in the world and thus enhancing operational **flexibility** (Mishra & Panda, 2019).

By supporting various models of services, such as IaaS<sup>11</sup>, PaaS<sup>12</sup> and SaaS<sup>13</sup>, it can accommodate the whole spectrum of a company / organization needs and thus make it **accessible** to all (Rashid & Chaturvedi, 2019).

Furthermore, due to the remote access to applications and data by many users, who can be in different places, it enables teamwork across geographical boundaries and thus **increasing collaboration**. Finally yet importantly, one significant benefit of cloud computing is its **disaster recovery capability** and **business continuity**, since cloud computing, apart from the robust backup, they often offer built-in solutions in case of disaster and in this way, they ensure data integrity and availability during outages (Qadi, 2024).

Despite the benefits, cloud computing, also presents significant challenges such as **data security issues**, where the risk of unauthorized access and data breaches is always present (Mishra & Panda, 2019), (Rashid & Chaturvedi, 2019). In addition, another issue is that companies are cautious and hesitant of trusting third-party vendors with sensitive data, so there are matters of **privacy** (Rashid & Chaturvedi, 2019). Other concerns that companies may have on the adoption of cloud computing services, include, **data management** challenges such as data recovery, data quality as well as the complexity faced by cloud providers due to regulatory compliance that may restrict data storage locations (Rashid & Chaturvedi, 2019). One other challenge that cloud computing brings, is the possibility of **vendor lock-in**, which happens mainly due to the costly and / or time-consuming switching from one vendor to the other or to the in-house infrastructure which makes companies hesitant to change cloud vendors (Shayan, Azarnik, Chuprat, Karamizadeh, & Alizadeh, 2013).

In conclusion, while cloud computing offers numerous benefits such as cost efficiency, scalability, flexibility, accessibility, increased collaboration capability, disaster recovery capability and business continuity, it also presents significant challenges such as data security and privacy, data management issues and vendor lock-in. Dealing with those concerns will further enable its wider adoption by companies.

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<sup>11</sup> IaaS = Infrastructure as a Service

<sup>12</sup> PaaS = Platform as a Service

<sup>13</sup> SaaS = Software as a Service

### 3.4 Internet of Things

The Internet of Things (IoT) has transformed the way business operate today with the unprecedented connectivity between devices that it provides, which leads to new business models with enhanced efficiency. Of course, that does not come without any challenges, which businesses must mitigate in order to gain the benefits of this technology.

The use of IoT devices provide **increased operational efficiency** as they systematize the operations by introducing minimal or no human intervention, by increasing the automation of processes and by permitting greater accuracy in data collection. All those changes lead to increased efficiency and in this way they reduce the operational costs (Taherdoost, 2023) (Nizetic, Solic, Gonzalez-de-Artaza, & Patrono, 2020). Another feature that increases operational efficiency is the real time monitoring of a company's assets, which improves inventory management. (HANNAN, CHOWDHURY, RAHAMAN, GALIB, & AHAD, 2022).

Another benefit is the provision of **data-driven insights**, which a company can achieve by using IoT devices that collect huge amounts of data and in this way, it will be able to make informed decisions and thus optimize its performance (Taherdoost, 2023). Furthermore, the integration of IoT technology with the cloud computing technology will further facilitate data analysis and sharing (HANNAN, CHOWDHURY, RAHAMAN, GALIB, & AHAD, 2022).

Of course we should not forget to mention the **cost savings** that we get by improving our operational efficiency and thus operational costs, as well as the optimization of the various utilities and usage of the various resources that leads to lower consumption (energy, water, materials, etc.) and waste (HANNAN, CHOWDHURY, RAHAMAN, GALIB, & AHAD, 2022) (Okorie, Udeh, Adaga, DaraOjimba, & Oriekhoe, 2024).

Another benefit of IoT technology usage for firms is that makes possible the gathering and analysis of customer data and in this way provides insights about the customer preferences and product usage. Firms using those analyses can provide tailored and personalized services to their customers as well as better products and thus provide an **enhanced customer experience** (Kumar, Tiwari, & Zymbler, 2019).

Special attention must be put to the **improvements in supply chain management** that IoT provides, as due to the real-time tracking feature of the IoT devices all goods and assets are

monitored effectively and we achieve reduced losses and transparency throughout the supply chain leading to a better inventory management (Chataut, Phoummalayvane, & Akl, 2023).

Finally, yet important benefit, is that the integration of IoT into businesses and the leveraging of the data that they collect from the IoT devices, can **create new business models**, such as predictive maintenance or subscription-based services (Elgazzar, et al., 2022).

Of course, with IoT, a business not only gets its benefits but also has to deal with some challenges. The most important one is the **security concerns** that IoT brings into a business. IoT devices are generally vulnerable to cyberattacks, and in this way sensitive data may be compromised, which makes robust security a necessity for a company that uses IoT. That need is further amplified by the fact that when using IoT devices, we are dealing with an enormous amount of connected devices that further complicates security management (Taherdoost, 2023) (Tarkoma & Katasonov, 2011) (Sultana & Tamanna, 2022). There is also an issue with **user data privacy** since the gathering of various types of data presumes adherence with complex regulations and enforcement of strict data governance policies (Kumar, Tiwari, & Zymbler, 2019).

Other issue is the **interoperability**, as various types of devices and protocols most probably have interconnection challenges and make problematic the communication between systems. **Standardization** also plays a significant role for interoperability and compatibility between different IoT devices and applications. The lack of both can create compatibility issues and problems in the integration and the scalability (Tarkoma & Katasonov, 2011) (Elgazzar, et al., 2022).

Same issues of compatibility, we also have with the **integration** of the IoT technology to the existing systems of a company, which is not related only to the technological differences but also to the required specialized expertise of the technical personnel that will manage this task (HANNAN, CHOWDHURY, RAHAMAN, GALIB, & AHAD, 2022).

IoT technology has also a **high implementation cost** due to the required high initial investment for the necessary infrastructure (IoT devices, networks, skilled personnel, etc.),



a burden that most SMEs<sup>14</sup> cannot afford (HANNAN, CHOWDHURY, RAHAMAN, GALIB, & AHAD, 2022).

IoT while offering significant benefits to a business such as increased operational efficiency, data-driven insights, cost savings, enhanced customer experience, improved supply chain management and the creation of new business models simultaneously has some important challenges that must be addressed like security, user data privacy, interoperability, standardization, integration and the high implementation costs in order to reach its full potential.

### 3.5 Blockchain

Blockchain technology has been a transforming factor for the business today. It offers a secure, decentralized and transparent solution for various business uses. By using Blockchain technology, a company may get many benefits, but there are also challenges that need to be addressed.

With the use of Blockchain, a company can **improve security and trust in transactions**. That is inherent to the decentralized nature of Blockchain where the data are distributed and kept between multiple nodes and thus minimizing the risk of failure at central points, the risk of fraud and the risk of unauthorized access to sensitive data. Apart from that, the use of cryptography and the consensus algorithms ensures the data integrity, ensures that transactions are secure and verifiable and creates trust among the users. Companies that require advance data protection can benefit from that (Rahman, Yeoh, & Pal, 2024) (Singh, 2022).

Blockchain also brings a **cost reduction**, as with the decentralized structure and the consensus algorithms it eliminates the need for intermediaries and minimizes transaction costs. Another benefit is the **operational efficiency** which is imposed by the automation of the various processes that reduce the administration overhead and accelerate the transaction times (Chang, Iakovou, & Shi, 2019). The immutable ledger allows for real-time tracking of transactions, which is particularly beneficial in supply chain management and e-commerce and thus providing **transparency and traceability** (Rahman & Hossan, 2024).

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<sup>14</sup> SMEs = Small and Medium-sized Enterprises



Blockchain also promotes the **development of new business models** like asset tokenization (which is the creation of tokens in a Blockchain or in another kind of distributed ledger that represent digital or physical assets, in this way the transaction is entirely immutable and no one can erase it) and Decentralized Finance - DeFi (DeFi is an peer-to-peer financial system that, through the use of Blockchain and cryptocurrencies, allows users to transact directly with each other, removing third parties like banks and financial institutions from the financial system and thereby reducing costs and transaction times). That creates new ways of value exchange and investment opportunities and thus giving a new potential for market reach and revenue generation (Singh, 2022).

There are also some challenges that need to be addressed when a business is using the Blockchain technology. With the continuous growth of the Blockchain networks, there is an increased risk of problems with the efficient handling of the transaction volume. That in turn, creates **concerns regarding scalability** and especially the reduced throughput and increased latency when this network is expanded, which influences the performance and hampers business applications that rely on Blockchain (Stiehle & Weber, 2022) (Rahman & Hossan, 2024).

There is also the issue of **regulatory and legal uncertainties**, which is important as the fast evolution of the Blockchain technology often outpaces the development of the respective regulatory frameworks. That creates problems to businesses using Blockchain, as they have to navigate through a complex legal and regulatory landscape for data privacy, compliance and jurisdiction, a thing that obstructs Blockchain adoption and innovation (Rahman, Yeoh, & Pal, 2024). The initial setup cost of the infrastructure and the integration of Blockchain systems includes **high implementation costs** that can be prohibiting for companies (Rahman & Hossan, 2024). Last but not least, is the issue of **integration with existing systems** that requires significant resources and specialized technical expertise for problems such as data mitigation, compatibility with existing systems (sometimes obsolete) and most importantly doing all that while maintaining operational continuity in the company. All this effort makes companies hesitant to adopt Blockchain technology (ISLAM, MUNIM, OISHWEE, ISLAM, & ISLAM, 2020).

In conclusion, Blockchain offers significant benefits to businesses such as transaction security and trust improvements, cost reduction, operational efficiency, transparency, traceability and development of new business models, but not without challenges such as

scalability concerns, regulatory and legal uncertainties, high implementation cost and integration issues with existing systems. A business should always make a thorough assessment and develop respective strategies in order to successfully employ Blockchain technology into their business model.

## 4. Opportunities and Challenges for Contemporary Business

In the previous chapters, we did an overview and an analysis of today’s major technological trends, which is AI, Big Data Analytics, Cloud Computing, IoT and Blockchain. The introduction of those technologies into the business world has revolutionized contemporary business practices and transformed the way businesses operate, especially in areas such as data-driven decision-making, digital transformation, remote work, virtual collaboration, and workforce adaptation. Those technologies, in this modern data-driven economy, drive the digital transformation, play a significant role in innovation, are essential for operational efficiency improvement and provide the competitive advantage to the businesses that successfully employ them.

In this chapter, we will examine how those technological advancements shape the practices and strategies of modern businesses with special focus on how they enhance efficiency, promote business agility and create new operational models. Apart from that, we will also highlight what kind of opportunities and challenges face the businesses that adopt those technologies.

### 4.1 Data-Driven Decision-Making

Big Data Analytics in conjunction with AI have become necessary tools for the business managers, making possible the data-driven decision making by the analysis of huge data sets in order to uncover hidden patterns and get insights and trends (Batko & Ślęzak, 2022), additionally Machine Learning algorithms, which is a subset of AI, can do the processing of huge amounts of data (either structured or unstructured) and from those can generate predictive analytics that can support the strategic decisions of companies (Sabharwal & Miah, 2021).

The applications of Big Data and AI that contribute in the decision-making for the businesses are the following:

- The **predictive analytics** function, which in plain words is the use of data to predict the future. In reality, AI algorithms analyze the historical data that are fed to them in order to forecast customer behavior, potential scenarios, market trends or operational risks and in this way, they help managers to make strategic decisions.

(Mucci & Stryker, 2024). Its application spans to various sectors as healthcare, finance, marketing, operations management and more.

- The **real-time decision-making** feature, which is inherent of the AI-powered analytics, as it allows businesses to make instant, data-supported decisions in dynamic environments (Sultana R. , 2024).
- The provision of **enhanced customer insights**, which is due to the real-time interactions (like chatbots and virtual assistants), the provision of personalized experiences (tailored marketing strategies after customer data analysis and prediction of customer preferences), analysis of heterogeneous data (that improve understanding of customer behavior and preferences) and algorithms that predict customer metrics (such as loyalty and likelihood of purchase) (Gupta & Khan, 2024) (Cristina Ledro, Nosella, & Vinelli, 2022).

Apart from AI and Big Data Analytics, Blockchain technology also contributes to the data-driven decision-making by enhancing the data security and the transparency in the decision-making process. That is done through the decentralized ledger that records transactions immutably. Especially for the sectors of finance and supply chain management, Blockchain is of extreme importance as it ensures data integrity and prevents tampering (Rahman & Hossan, 2024) (Rahman, Yeoh, & Pal, 2024) (Singh, 2022).

The applications of Blockchain that contribute in the decision-making processes of the businesses are the following:

- The **data integrity** feature, which is inherent of Blockchain technology as whatever transaction is recorded, due to the decentralized nature of Blockchain (the data are distributed and kept between multiple nodes), cannot be altered and thus ensures trust and reliability (Rahman, Yeoh, & Pal, 2024) (Singh, 2022).
- The **smart contracts** function that enables the automation of the decision-making processes by the contract self-execution and in this way it reduces the administrative overhead (Chang, Iakovou, & Shi, 2019).
- The **fraud prevention** mechanism, as the use of secure cryptographic protocols greatly reduces the risk of fraudulent activities in financial transactions that executed through the use of Blockchain (Stiehle & Weber, 2022)

Implementing AI, Big Data Analytics and Blockchain, as we showed above, certainly promotes the Data-Driven Decision-Making across various sectors, however they present several challenges for the businesses that adopt them. For the integration of AI with big data, there is the issue of **data quality and management** as data availability, bias, and management complexities can influence negatively AI performance. Other issue is **interpretability and transparency**, as most AI models often resemble to "black boxes" and this lack of transparency is an obstacle for trust and acceptance among users. **Security and privacy** is also a concern, as sensitive information must be protected from adversaries and we have to ensure compliance with the regulatory framework (e.g. GDPR) (Jagatheesaperumal, Rahouti, Ahmad, Al-Fuqaha, & Guizani, 2021) (Luan, et al., 2020). **Scalability** poses an issue as we may face slower transaction speeds as the network grows and that affects the efficiency of the applications. **Regulatory and compliance** considerations must be made, as Blockchain due to its decentralized nature can conflict with existing regulatory frameworks, creating uncertainties in compliance and legal recognition (Taherdoost, Blockchain Technology and Artificial Intelligence Together: A Critical Review on Applications, 2022). **Integration with existing systems** most of the time demands significant changes, creates compatibility and interoperability issues and needs careful planning and execution (Akter, Michael, Uddin, McCarthy, & Rahman, 2020). There is also the issue of **resource intensiveness**, as the high computational demands of AI and Big Data analytics along with Blockchain's processing requirements can put a significant burden on resources which in turn may lead to high investments and thus to **high implementation costs**.

A complete strategy is needed to address these issues, one that involves creating strong data governance guidelines, making scalable infrastructure investments, encouraging interdisciplinary cooperation and working with regulatory agencies to establish frameworks that are helpful. Organizations may fully utilize AI, Big Data, and Blockchain in their digital transformation endeavors by proactively addressing these challenges.

## 4.2 Digital Transformation

Cloud computing is a fundamental and critical facilitator of digital transformation of businesses, as it offers on-demand computing resources that can be also scalable and as such, it promotes business agility. Businesses and organizations, by using IaaS, PaaS and

SaaS, can optimize their operation and promote innovation while reducing costs (Mishra & Panda, 2019).

The features and applications of Cloud computing that contribute in the digital transformation of the businesses are the following:

- The **cost efficiency**, which cloud computing, provides that eradicate the requirement for expensive infrastructure at the business premises (Attaran, 2017).
- The **scalability** feature of cloud computing that permits businesses to easily adopting changes in the demand of computing services (increase or decrease for IaaS, SaaS and PaaS) without having to pay any upfront cost of the equipment or the infrastructure investment (Rashid & Chaturvedi, 2019).
- The **business continuity** function, as cloud computing offers robust backup features as well as solutions in case of a disaster, ensuring data integrity and availability during outages and thus providing business continuity (Qadi, 2024).

Apart from Cloud Computing, Internet of Things also contributes to the digital transformation, by providing an unprecedented connectivity between physical devices and the digital world, by optimizing efficiency, by enhancing customer experience and leading to new business models (Taherdoost, 2023).

The features and applications of Internet of Things that contribute in the digital transformation of the businesses are the following:

- The **predictive maintenance** capability that now businesses have, as with the use of IoT sensors they constantly monitor their equipment and can detect malfunctions before they occur. In this way, they reduce the downtimes of the equipment as well as the maintenance costs (Nizetic, Solic, Gonzalez-de-Artaza, & Patrono, 2020).
- The **smart logistics** feature which is enabled by the use of the real-time tracking of the supply chain that provides better monitoring, reduce losses and transparency (Chataut, Phoummalayvane, & Akl, 2023) and the real time monitoring of its assets which improves inventory managements (HANNAN, CHOWDHURY, RAHAMAN, GALIB, & AHAD, 2022).
- The **customer experience enhancement** feature, which is achieved by the tailoring and personalization of the provided services to customers using the real-time data gathered by the IoT sensors (Kumar, Tiwari, & Zymbler, 2019).

Implementing Cloud Computing and Internet of Things, as we showed above, is certainly pivotal for the Digital Transformation across various sectors, however they present several challenges for the businesses that adopt them. The combination of IoT devices with cloud infrastructures introduces significant **security and privacy issues**. IoT devices due to their limited computational capabilities are prone to cyber threats and depending on the sensitivity of the data they handle that may lead to serious data breaches. Due to this reason robust security measures and ensuring data privacy are necessary (Taherdoost, Security and Internet of Things: Benefits, Challenges, and Future Perspectives, 2023) (Kumar, Tiwari, & Zymbler, 2019). IoT devices generate a huge amount of data that only can be accommodated in the cloud, where they have to be uploaded, creating issues of latency due to the continuous inflow and the huge volume, so data **management and storage** is of the essence. Another issue is the **interoperability and standardization**, as due to the variety of IoT devices and the absence of equipment standardization there are connectivity issues that hinder the interoperability between devices (Kumar, Tiwari, & Zymbler, 2019). **Latency and Real-Time Processing** is an issue, as some IoT applications require real-time data processing and when combined with cloud computing that can create latency issues, compromising the effectiveness of these applications (Vo, Dave, Bajpai, & Kashef, 2022). **Resource constraints and scalability**, poses also a challenge, as IoT devices have limited resources with respect to power and processing and when integrated with cloud services, there is the need for lightweight and efficient protocols to ensure scalability and functionality without overburdening the devices (Belgaum, et al., 2017). IoT devices and cloud platforms exchange data in a global environment, this raises **regulatory and compliance** challenges, such as data protection laws, regulations across different regions, local and international standards that businesses should address (Liu, Ni, Karlsson, & Gong, 2021). Legacy systems along new digital tool increase the **integration complexity** for the adopting businesses and brings the possibility of **vendor lock-in** as businesses are often hesitant of switching vendors (Shayan, Azarnik, Chuprat, Karamizadeh, & Alizadeh, 2013). Other challenges are the **resistance to change** by employees due to skill gaps or uncertainty (Bouwdad & Lafraxo, 2024) and the **high implementation cost** due to the required high initial investment for the necessary infrastructure (HANNAN, CHOWDHURY, RAHAMAN, GALIB, & AHAD, 2022).



Addressing these difficulties involves a holistic strategy, which includes improving security protocols, building efficient data management techniques, defining interoperability standards, implementing edge computing solutions, designing scalable architectures, and assuring regulatory compliance. By addressing these difficulties, enterprises may successfully capitalize on the synergy between Cloud Computing and IoT to create successful digital transformation efforts.

### 4.3 Remote Work and Virtual Collaboration

In recent years, remote work and virtual collaboration have drastically changed the modern workplace. Due to the COVID-19 epidemic as well as the technological improvements, remote work has become a more attractive option for companies and workers than traditional office-based operations. AI-powered chatbots and virtual assistants along with AI-driven cloud-based collaboration tools (Microsoft Teams, Zoom etc.) have enabled this virtual collaboration and remote work while improving communication and enhancing productivity (Sultana & Tamanna, 2022).

The features and applications of AI that contribute in the remote work and virtual collaboration within businesses are the following:

- The **automated workflows** feature of AI-powered systems can dynamically adjust schedules, allocate resources, and optimize functions and thus streamline repetitive tasks and improve efficiency (Waqar, Bhatti, & Khan, 2024).
- The **enhanced communication** feature which is possible due to the Natural Language Processing (NLP) that AI technology provides, plays a significant role in cross-border collaboration (e.g. payments) (Chatterjee, 2022).
- The **Virtual Workspace** feature that AI-powered messaging and collaboration platforms provide along with the increasing development of sophisticated applications that help us to solve problems that will eventually turn into the operating system of the virtual workplace (Ashri, 2020).

While the traditional security measures rely on centralized systems that are vulnerable to cyberattacks, Blockchain, with the decentralized authentication, the encryption, and the digital identities that are immune to fraud, improves security, so integrating Blockchain technology into the remote work and virtual collaboration environment can significantly enhance security (Rahman, Yeoh, & Pal, 2024).



The features and applications of Blockchain that contribute in the remote work and virtual collaboration within businesses are the following:

- **Secure access management** in remote work and virtual collaboration can be significantly enhanced through the integration of Blockchain technology by providing a secure, decentralized and tamper-proof solution. Blockchain improves access control and is becoming more widely recognized as a viable means of improving security and instilling trust in cloud systems (Punia, et al., 2024).
- **Decentralized Access Control**, as Blockchain provides a decentralized framework that enhances security by distributing access control policies across multiple nodes in contrast to traditional centralized access control systems that are vulnerable to single points of failure (Xi, Liu, Li, & Qin, 2022).
- Blockchain supports the **development of decentralized collaboration platforms** that facilitate the trustworthy data sharing and collaboration among users without centralized oversight, transforming the virtual collaboration in various sectors (Wang, Tripathi, Farshidi, & Zhao, 2024).
- **Tamper-proof digital contracts** are possible by using the smart contracts characteristic of Blockchain and in this way streamlining of the remote employment agreements is possible (Alabdulkarim, et al., 2023).

Integrating AI and Blockchain technology into remote work and virtual collaboration frameworks has various benefits, as we analyzed above. However, businesses must overcome various hurdles in order to take full advantage of their potential. AI systems frequently require access to vast amounts of personal and sensitive data, increasing the risk of data breaches and unauthorized access. That creates significant **privacy and security concerns** that require robust data protection measures (Elliott & Soifer, 2022). The **excessive reliance on AI-driven tools** may lead to a decline in critical thinking and decision-making skills among remote workers, which happens because users may accept AI-generated recommendations without sufficient scrutiny, resulting in errors and lower overall performance. Balancing automation with human oversight is critical to mitigate these risks (Passi & Vorvoreanu, 2022). Implementing Blockchain in virtual collaboration platforms can create **scalability issues** and in this way is affecting the transaction speeds and the overall system performance as the number of users grows. The integration of Blockchain with existing collaboration tools and workflows can be difficult, creating

**integration complexities** such as compatibility issues and large modifications to corporate infrastructures (Taherdoost, Blockchain Technology and Artificial Intelligence Together: A Critical Review on Applications, 2022).

Combining AI and Blockchain technologies creates challenges in the **technical integration** of the systems such as compatibility and ensuring seamless communication. Furthermore, both are **resource-intensive** technologies that can put a strain on computing resources, resulting in higher expenses and possible inefficiencies (Salah, Rehman, Nizamuddin, & Al-Fuqaha, 2018).

Addressing these challenges demands a multifaceted strategy that includes building strong data governance principles, investing in scalable infrastructure, encouraging multidisciplinary cooperation, and working with regulatory agencies to provide supporting frameworks. Companies, by proactively addressing these challenges, can exploit the full potential of AI and Blockchain in improving remote work and virtual collaboration.

#### **4.4 Workforce Adaptation**

The introduction of AI and automation in the job environment has reshaped the job roles. This constantly changing business environment requires employees to gain new skills and / or grow their existing ones and that in turn demands that businesses invest in workforce upskilling and reskilling. Upskilling and reskilling not only contributes to employee's overall development and career growth but also safeguards the future of the workforce and the businesses as well (Pradhan & Saxena, 2023 ).

AI plays a significant role in the workforce adaptation as the last years it has become an integral part of e-learning platforms and is used in a collaborative matter along with human agents in the decision-making.

The features and applications of AI that contribute in the workforce upskilling and reskilling within businesses are the following:

- **E-learning platforms**, powered by AI and ML, are a transformative factor for education. They offer personalized and tailored learning experiences, real-time feedback and progress tracking and opportunities for dynamic content generation. In this manner, they enhance student engagement, foster self-directed learning, and improve overall learning outcomes (Gligorea, et al., 2023).

- **Human-AI Collaboration** can be better than the human-controlled or the fully autonomous by AI agents; it also requires lower mental and temporal demands and reduces human effort (Islam, et al., 2023).

Apart from AI, internet of things also contributes to the workforce adaptation by optimizing workplace productivity with the automation of the administrative tasks and provision of the real-time analytics of employee performance (A-teamGlobal, 2023) (Mariani & Monahan, 2016).

The features and applications of internet of things that contribute in the workforce upskilling and reskilling within businesses are the following:

- **Remote Workforce Monitoring**, which is the engagement and performance tracking of employees using real-time analytics from IoT sensors (Mariani & Monahan, 2016).
- **Wearable IoT devices** that are used in order to monitor employee's stress and attention levels and ultimately their health and safety (Traunmuller, Jahanjoo, Khooyooz, Aminifar, & Taherinejad, 2024).
- **Smart Workspaces**, where IoT-enabled devices adjusting environmental factors such as lighting, temperature and occupancy in order to create personalized and efficient workspaces and transform the traditional workplace into a smart, adaptive space that enhance employee productivity and satisfaction (Mariani & Monahan, 2016).

As demonstrated above, AI and IoT undoubtedly contributes positively to the workforce adaptation across a range of industries increasing efficiency and productivity, but they also pose a number of difficulties for the companies that use them.

Due to the fact that AI can automate routine tasks, it may cause **job displacement**, especially in industries like manufacturing and customer service, requiring workforce reskilling in order for the employees to learn new competencies and bridge the **skill gaps** (Patil, 2024). The plethora of IoT devices in the workplace poses a significant **privacy and security challenge**, and require robust security, as these devices collect huge amounts of data and create issues of data breaches or unauthorized access (Mazhar, et al., 2023). The introduction of those technologies often faces **resistance from employees** due to the fear of losing their jobs and / or changes in the work processes. In order to counter this, and ensure a smooth

transition, there is the need for an effective **change management** strategy (Wikipedia, Fourth Industrial Revolution, 2025). Furthermore, AI and IoT raise **ethical concerns** and have the ability to intensify socioeconomic inequalities by affecting specific job sectors. Certain proactive measures must be put in place in order to address them (Inman, 2025).

Addressing these challenges entails a comprehensive approach that includes continuous learning initiatives, strong security protocols, effective change management, and ethical considerations to ensure that the workforce can effectively adapt to the changing technological landscape.

## 4.5 Chapter Summary

The integration of AI, Blockchain, Big Data, Cloud Computing and IoT is revolutionizing modern businesses, offering both limitless opportunities and significant challenges. These technologies enable data-driven decision-making, accelerate digital transformation, enhance remote work capabilities, and improve workforce adaptability. However, organizations must also navigate cybersecurity threats, regulatory compliance, and skill shortages to fully harness their potential. Successfully adopting these innovations requires a strategic focus on digital infrastructure and continuous employee training. Businesses that invest in upskilling their workforce and implementing robust security measures will be better positioned for sustainable growth. Moreover, balancing technological advancements with ethical considerations and regulatory frameworks is essential to long-term success. As digital transformation continues to reshape industries, companies that proactively address these challenges will gain a competitive edge in an increasingly technology-driven market. A forward-thinking approach to digital adoption will be crucial for thriving in the evolving business landscape.

## **5. Case Studies and Industry Applications**

By analyzing some case studies and industry applications, the dissertation highlights the impact those technologies have across various sectors, but also provides a critical view regarding the challenges businesses face by adopting them. The results of the analysis shows that the strategic decision to use these technologies in a business provides growth and long-term sustainability.

In this section, we will examine some case studies of companies from various sectors adopting AI, Blockchain, Big Data, Cloud Computing or IoT in their operation frameworks and what are the conclusions of such endeavor.

### **5.1 Insurance Sector (BGL Group)**

Taking the example of BGL Group that operates in the insurance sector, the integration of AI in its operations reshapes the operation framework and enhances the customer engagement. This case study illustrates that AI applications can drive significant improvements in efficiency and service delivery. Specifically, AI applications create business value by integrating into the BGL Group’s customer lifecycle model and in this way affecting various stages of the customer lifecycle from the acquisition phase to the retention phase. They also improve BGL Group’s data-driven decision making as by leveraging the dig data enable BGL Group to refine its value proposition and target customers more effectively. They also help them to maintain their competitive position in the market by cultivating a digital-first culture and by rapidly prototyping AI ideas and in this way giving to BGL Group strategic advantages. This case study highlights the transformative potential of AI in enhancing operational efficiency and customer satisfaction in the insurance industry, suggesting a need for ongoing innovation and strategic integration but also brings into consideration factors as the need for an ethical use of customer data, the avoidance of algorithmic bias, the transparency of AI systems as well as the explanations of automated decisions (Holland, 2022).

### **5.2 Financial sector (JP Morgan, Allstate Insurance, Black Rock, HSBC)**

Taking the example of the financial services sector, we see that the integration of data analytics and information systems is a determining factor enhancing the operational efficiency, improving the risk management and the customer satisfaction. As far as the

operational improvements, JP Morgan, by utilizing AI-driven analytics achieved a reduction of 30% in fraud-related losses and an increase of 20% in customer satisfaction through personalized services and Allstate Insurance, by implementing predictive analytics, achieved a reduction of 40% in the claims processing time and an improvement of 25% in underwriting accuracy. As far as the risk management enhancements, Black Rock, by leveraging ML for the optimization of its investment portfolio, got an increase of 35% in returns, while Bank of America, utilizing data analytics, enhanced the customer relationship management and achieved an increase of 22% in customer retention. Those case studies show that big data analytics, when adopted by companies of the financial sector for integration with their information systems, can reduce fraud related losses, streamline claims processing, optimize investment portfolios and enhance customer engagement through personalized services. Furthermore, the research shows that the evolution of these technologies will play an even more critical role in shaping the future of financial services (Barua & Barua, 2024).

HSBC is a leading company in the financial sector and mainly uses AI technologies, such as ML, NLP, and robotics, which are more customer-oriented, with the target to promote a better customer / user experience, to reduce the operational and work force cost, and to improve productivity and efficiency. HSBC, with respect to the managerial effectiveness of AI introduction into its business model, achieves an improvement in the fraud detection mechanism, an operational cost reduction and compliance with the regulations. It also enhances the customer experience and satisfaction by providing timely assistance with the use of chatbots. HSBC managers should pay special attention to AI development and usage, especially in the area of customer service, data analytical skills, and new revenue breakthroughs. The challenges that are faced by HSBC are data and cyber security and the lack of understanding, knowledge and talents in AI (Qi & Qi, 2019).

### **5.3 Entertainment sector (iQiYi)**

iQiYi is a leading company in the online entertainment industry and it also uses ML, NLP, and robotics, with the objective to have a better customer / user experience, to reduce the operational and work force cost, and to enhance productivity and efficiency. iQiYi, by introducing AI in its operational model, improves the user experience due to the personalized content recommendations, improves the operational efficiency and leads to significant revenue increases, as AI-driven innovations impact business performance. For

that reason, iQiYi managers, should pay special attention to the areas of customer service, data analytical skills, and new revenue breakthroughs. Data security, cyber security and the lack of understanding, knowledge and talents in AI are the most important challenges that are faces by iQiYi when introducing AI in its operational model (Qi & Qi, 2019).

#### **5.4 Automotive sector (Jiangling Motors Group, Tesla)**

In the example of Jiangling Motors Group, the company is leveraging AI and digital technologies to enhance its competitive advantage in the automotive industry. The strategic integration of these technologies in manufacturing, smart driving and marketing, position the company as a leader within the industry disruptions. Furthermore, this integration also highlights the need of proactive technological adoption in order to maintain competitiveness. AI and digital technologies promote manufacturing efficiency, as AI streamlines production processes, reducing costs and improving output quality. It also provides smart driving capabilities by enhancing vehicle intelligence and contributing to safety and user experience. The digital tools make possible the use of targeted marketing strategies and thus improving customer engagement and satisfaction. There are also challenges involved, such as data privacy, ethical issues and organizational resistance that introduce complexities and risks that must be addressed in order to fully realize their potential (Zhu, 2024).

Tesla is a global leader in the automotive sector and started to use AI technology in marketing as early as 2013. Taking into account the three-phase framework proposed by Huang & Rust (Huang & Rust, 2020), Tesla implements AI in the marketing research stage, in the marketing strategy building stage and in the marketing action stage. In the first stage Tesla uses mechanical AI technology to automate large-scale data collection by the sensors of its vehicles and understand vehicle performance, vehicle condition and driver's condition, then uses thinking AI to identify the latest trends and dynamics in the marketplace in order to develop better products and perceptual AI to predict consumers' intention to buy a car and gain insights into their satisfaction with the product. In the second stage, mechanical AI from massive data such consumer purchasing behavior and shopping preferences, performs the market segmentation, thinking AI explores the potential value of each market segment and does the selection of market targets and perceptual AI captures the purchasing behavior of customers by analyzing data such as user evaluation and social media interaction. In the last stage Tesla uses mechanical AI to automate and standardize the production process



ensuring quality, improving productivity and reducing the possibility of errors, thinking AI to provide a more attentive and personalized service to each customer and perceived AI to further increase customer satisfaction and loyalty to the Tesla brand. Of course, we have to underline that AI is not omnipotent and that businesses should be aware of its limitations and potential hazards when implementing it (Tai, 2023).

### **5.5 Consumer Technology sector (Samsung, Haier)**

Samsung operates in the consumer technology sector and uses AI in its products to improve product features and user experience. It's assistant (Bixby) provides personalized service and improves the user interaction while smart IoT solutions optimize the energy efficiency of Samsung's home appliances. Furthermore, the use of AI technology in production reduces the cost by streamlining the manufacturing processes and predictive analytics monitor the equipment wear and tear providing valuable information for the equipment maintenance. Additionally, the data-driven decision-making improves the overall operational effectiveness. Samsung, with AI introduction in its business, gains a competitive advantage in the technology sector. The integration of AI in Samsung's products enhances the functionality, usability and the operational efficiency, providing benefits in the manufacturing processes. The implementation of AI creates a smarter environment, is fostering the brand loyalty and creates new sources of income and in this way distinguishes Samsung from its competitors. There also risks associated with AI implementation from Samsung such as data privacy, lack of expertise and dominance by AI giants in the field as well as opportunities for the company to push AI to new applications such as generative and explanatory AI (Embarka, Abdellatif, Fatma, & Salima, 2024).

Haier operates in the consumer technology sector and uses IoT in its products, to create a more convenient and natural interaction experience for users, as well as a combination of sensors and big data functions to provide personalized services for users (upgrade from passive response to active judgment). Haier also transitioned from digital finance to IoT finance, which introduces decentralization that transforms finance into a series of capabilities that integrate into a product or scenario. In the manufacturing sector, IoT introduction, is not only about technological innovation in products, but also about upgrading management models, enterprise organizational structures, financial tools, and other aspects such as strategies or business models for companies based on users, adaption to changes, improvements in the organizational structure of the company and innovative



financial tools. Haier, with the application of big data, AI technology, and smart home core technology, experienced high annual growth rates and steady increments in their net profits since 2020 (Liu S. , 2023).

## **5.5 E-commerce sector (Alibaba)**

Alibaba, a leader in the e-commerce sector, in the era of big data utilizes business intelligence technology, which is a process that uses data analysis tools and technologies to gain business insights and provide support for making future strategic decisions. It uses technologies and applications such as data warehousing, data mining, dashboard and reporting tools, data metrics, predictive analysis and self-service analytics tools.

Alibaba employs business intelligence in its intelligent recommendation system, where with the analysis of the user search behavior data and shopping history creates personalized recommendations and significantly enhances the user's shopping experience and increases sales. By analyzing the user behavior and optimizing the strategy, Alibaba identifies changes and trends and properly adjusts recommendation strategies ensuring users receiving product recommendations aligned with their interests and therefore improving their satisfaction.

Alibaba, also employs intelligent marketing strategies with personalized promotion based on in-depth user behavior analysis and tailored customization that boosts user satisfaction and increases the likelihood of making a purchase, as well as data-driven coupon recommendations based on analysis of users' purchase histories, shopping carts items and browsing records and in this way increasing sales and user loyalty to the Alibaba company.

Alibaba also uses intelligent supply chain management and specifically data-driven insights by the real-time processing and analyzing of huge amounts of data (inventory management, order processing, transportation, customs clearance) providing valuable insights into the flow of goods and the potential bottlenecks, contributing to the supply chain efficiency. With the real-time monitoring and tracking technologies (sensors, IoT devices), Alibaba tracks each stage of the supply chain and with this high level of visibility they can respond rapidly to any issues or delays and by performing data analysis, leveraging AI and ML to dynamically adjust routes to changing conditions, they optimize the transportation efficiency and reduce the cost.

This case shows that big data analytics used along with other tools in the business intelligence framework, transforms data into valuable information, providing a decision-

making tool based on facts, improving the operational efficiency, reducing costs, discovering new market opportunities, promoting product innovation and personalized services and finally enhancing user experience (Zhang, 2024).

## 6. Conclusions and Recommendations

The integration of AI, Big Data Analytics, Blockchain, Cloud Computing, and the IoT has transformed the business landscape, and has created unparalleled opportunities as well as challenges for businesses. Organizations all over the world are using these technologies to promote digital transformation, to improve the decision-making, to optimize their operations and to engage customers more effectively. Those benefits do not come alone though, businesses have to cope with challenges such as cybersecurity threats, regulatory compliance, ethical concerns, and workforce adaptation. Below, we will summarize the key findings of this dissertation and we will provide the conclusions and recommendations for the businesses that seek to maximize the benefits of those technologies while mitigating the challenges.

The key findings of using those disruptive technologies can be summarized as follows:

- AI and Automation: Technology solutions that are driven by AI have transformed industries by improving the efficiency, by automating the processes and making possible the data-driven decision-making. The AI functions of Machine Learning and Natural Language Processing improve the customer service, the risk assessment and make possible the predictive analytics, giving to the businesses a competitive advantage. However, implementing a technology such as AI demands close supervision in order to avoid ethical dilemmas, such as algorithmic bias and job displacement.
- Big Data Analytics for Analysis: The businesses that are leveraging the Big Data analytics are able to get beneficial insights into the market trends, the customer behaviors and the operational efficiencies that can be achieved. The strategies stemming from big data analytics improve the business agility and permit businesses to respond quickly to the market changes. Nonetheless, there are concerns with respect to data privacy, to storage limitations and to processing, that must be dealt with, in order to maximize the effectiveness of Big Data Analytics applications.
- Blockchain for Security and Transparency: The use of Blockchain technology improves the security of transactions, prevents the data tampering, and promotes the transparency in digital transactions. Blockchain has been successfully used by businesses in sectors such as finance, supply chain, and digital identity verification

and has improved the trust and has reduced fraud. There are, though, issues with scalability, energy consumption as well as regulatory uncertainties that prohibit its widespread adoption.

- Cloud Computing for Scalability and Flexibility: Cloud solutions provide to the businesses a cost-effective and scalable IT infrastructure, supporting them in managing workloads efficiently. Furthermore, the adoption of cloud solutions, has enabled remote work, helped the collaboration and made possible the access to critical applications that otherwise would not be possible. However, there are significant obstacles such as data security risks and vendor lock-in.
- IoT in Smart Business Environments: IoT devices enable the real-time monitoring of objects – items – people, the predictive maintenance of machinery and the automation in sectors such as manufacturing, healthcare and logistics. Despite the fact that IoT improves productivity and operational efficiency, there is the risk of security vulnerabilities and data breaches that call for robust cybersecurity measures.

Businesses, in order to get the full benefit of these emerging technologies while mitigating the associated risks, should take the following strategic approaches:

- Invest in Digital Infrastructure: The investment in modern IT infrastructure to support AI, Big Data, Blockchain, Cloud Computing and IoT initiatives should be a priority for businesses. They also have to adopt cloud-based solutions in order to improve scalability and flexibility but at the same time, they have to strengthen their cybersecurity frameworks for the purpose to protect sensitive data from cyber threats.
- Workforce Upskilling and Adaptation: When a business wants to adopt advance technology in its operation, most of the time, it needs to upskill or reskill its personnel as well. In order to accomplish that, businesses, have to establish training programs that will provide to their employees digital literacy, data analytics proficiency and AI governance skills. The best approach for businesses would be to collaborate with academia and/or online learning platforms to facilitate continuous education and adaptation.
- Ethical AI and Regulatory Compliance: In order to ensure a responsible AI usage and to prevent the AI bias, businesses, should put in place ethical AI frameworks

and promote transparency. The regulatory compliance has to be a priority, especially regarding data protection legislation such as GDPR. Apart from that, any AI decision-making processes have to incorporate also ethical considerations to foster trust and accountability.

- Cybersecurity and Data Protection: As we analyzed in many parts of this dissertation, one of the major issues with all those emerging technologies is the cyber threat, so businesses have to implement robust cybersecurity policies such as encryption, multi-factor authentication and AI-driven threat detection. As data integrity is an inherent feature of the Blockchain technology, businesses should examine its integration into their security frameworks.
- Strategic AI and IoT Integration: The integration of AI along with IoT should be a strategic priority for businesses as it optimizes productivity and promotes innovation. The features of predictive analytics improve the supply chain efficiency and the smart IoT-enabled devices provide a better workplace safety and improve operational intelligence. Nonetheless, IoT data collection creates privacy concerns that must be addressed.
- Leveraging Blockchain for Transparency: Blockchain provides transparency and transaction security and sectors such as finance, healthcare, and logistics can benefit from those features. In the case of automated transaction, smart contracts can be the solution while authenticity and fraud prevention can be ensured by using digital identity solutions.
- Encouraging Innovation and Collaboration: Businesses should support the interdisciplinary cooperation and the allocation of resources for research and development in order to cultivate an innovative culture within their organization. Initiatives for digital transformation can be accelerated through collaborations with startups, academic institutions and technology companies.
- Sustainable Technology Adoption: Sustainability should be a priority in any endeavor to adopt those emerging technologies. Businesses must evaluate how Blockchain and artificial intelligence will affect the environment while looking into energy-saving options like carbon-neutral cloud infrastructures and green computing.

The digital era provides many opportunities for businesses willing to grasp technological advancements. Emerging technologies such as AI, Big Data Analytics, Blockchain, Cloud Computing and IoT have transformed how businesses operate offering increased efficiency, security and scalability. Nonetheless, businesses have to overcome significant obstacles like cybersecurity risks, workforce adaptation and regulatory compliance.

Sustainable success will require a balanced approach that includes ethical considerations, strategic investment and continuous innovation. In an increasingly digitalized global market we are live in, the companies that will take proactive measures to address these issues and will take advantage of the technology advancements will achieve a competitive advantage. Business future depends on having a data-driven mindset, establishing a culture of continuous learning and embracing responsible and innovative technology adoption practices.

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