The Impact of Technology on the Digital Platform Economy

Björn Finkenberger

The Impact of Technology on the Digital Platform Economy

Wissenschaftlicher Verlag Berlin
wvb

Bibliografische Informationen der Deutschen Nationalbibliothek

Die Deutsche Nationalbibliothek verzeichnet diese Publikation in der Deutschen Nationalbibliografie; detaillierte bibliografische Daten sind im Internet über http://dnb.ddb.de abrufbar

ISBN 978-3-96138-378-8

Druck und Bindung: SDL – Digitaler Buchdruck, Berlin
Printed in Germany
€ 42,00

Table of Contents

List of Abbreviations

AI - Artificial Intelligence
ALU - Arithmetic Logic Unit
ANT - Actor-Network Theory
AR - Augmented Reality
AVOD - Advertising Video On Demand
AWS - Amazon Web Services
CDN - Content Delivery Networks
CNN - Convolutional Neural Network
COPPA - Children´s Online Privacy Protection Act
CPU - Central Processing Unit
CRM - Customer Relationship Management
CTR - Click Through Rate
DAU - Daily Active Users
DMCA - Digital Millennium Copyright Act
DNS - Domain Name System
DPO - Data Protection Officer
DRM - Digital Rights Management
EBITDA - Earnings Before Interest, Tax, Depreciation, and Amortization
ECPA - Electronics Communication Privacy Act
ERP - Enterprise Resource Planning
EST - Electronic Sell-Through
FCC - Federal Communications Commission
GAN - Generative Adversarial Network
GCP - Google Cloud Platform
GDPR - General Data Protection Regulation
GMV - Gross Merchandise Volume
GPU - Graphics Processing Unit
HHI - Herfindahl-Hirschman Index
HIPAA - Health Insurance Portability and Accountability Act
HTTP - Hypertext Transfer Protocol
IaaS - Infrastructure-as-a-Service
IoT - Internet of Things
IP - Intellectual Property
ISS - Information Society Services
JSON - JavaScript Object Notation
KPI - Key Performance Indicator
LGPD - General Data Protection
M&A - Mergers and Acquisitions
MAU - Monthly Active Users
MENA - Middle East & North Africa
MQTT - Message Queuing Telemetry Transport
MR - Mixed Reality
NFT - Non Fungible Token
NLP - Natural Language Processing
NPD - New Product Development
OS - Operating System
OTT - Over the Top
PaaS - Platform-as-a-Service
PC - Personal Computer
R&D - Research And Development
RFPA - Right to Financial Privacy Act
RNN - Recurrent Neural Network
ROI - Return On Investment
SaaS - Software as a Service
SCP - Structure Conduct Performance Analysis
SMB - Small And Midsize Business
SMTP - Simple Mail Transfer Protocol
SoC - System on a Chip
SSL - Secure Sockets Layer
SVOD - Subscription Video On Demand
TCP - Transmission Control Protocol
TCP/IP -Transmission Control Protocol/Internet Protocol
TLS - Transport Layer Security
ToS - Terms of Service
TPU - Tensor Processing Units
TVOD - Transactional Video On Demand
UGC - User-Generated Content
UPnP - Universal Plug and Play
USB - Universal Serial Bus
UX - User Experience
VR - Virtual Reality
WMP - Windows Media Player
XML - Extensible Markup Language

1 INTRODUCTION AND PROBLEM STATEMENT

The digital platform economy is a rapidly growing sector of the global economy, and the impact of technology on this sector has been profound. Digital platforms, which facilitate the exchange of goods, services, and information in a networked environment, have disrupted traditional business models and created new opportunities for growth and innovation. These platforms have enabled small businesses and entrepreneurs to reach a wider audience, creating new markets, and driving economic growth. The increasing adoption of digital platforms has been perceived to create a more favorable global environment, akin to the ground-breaking advancements that characterized the era of the Florentine Renaissance (Weiner, 2016; Barbieri, 2018; Keese, 2016), when they were first introduced. Today, digital platforms are ubiquitous across many sectors of the economy and are dominated by companies such as Alphabet, Meta, Amazon, TikTok, Uber, and Airbnb. These platform operators are global companies whose services are available worldwide, challenging traditional actors who dominate the global economic order with their goal of opening new sales markets.

The value creation principle (McGee, 2014b: 1-4) of these new companies is different as they organize themselves as platforms. While it is not always clear what the core activity and related added value of these platforms is, they may function either as the actual product or as the mediator between suppliers and buyers in all types of business transactions. The advantages brought about by technological progress through online platforms notwithstanding, they are currently being scrutinized from different angles due to the obstacles posed by the impact of technology on the digital platform economy. The concentration of market control within the grasp of a select few influential platforms is one of the foremost issues causing apprehension. The concentration of market power can limit competition, reduce innovation, and ultimately harm consumers' interests. Additionally, there are concerns about the impact of automation on employment and the potential for technology to exacerbate existing inequalities in society (cf. Keese, 2016: 228-246). The US-based dominant online platforms are being increasingly scrutinized and seen as a threat in political and public discussions. The accusations against them range from misuse of their power to the harmful influence on democratic processes, excessive data collection, the creation of a dependent workforce, and tax evasion. These concerns have led to radical demands for regulation, breaking up company structures, or nationalization. However, the success of US platform companies is due to their entrepreneurial skills rather than their size, which is not a prerequisite for success (cf. Parker et al., 2016: 22-39; Hamann, 2018; Mayer-Schönberger, 2017; Galloway, 2017: 1-12).

Most of the current online platform giants were initially small start-ups, and their success was not due to mergers with established large companies. Instead, their success can be attributed to innovative and revolutionary ideas that allowed them to prevail against existing companies, even though they did not operate in a vacuum of competition. For instance, Google was not the only search engine around at the time, and Facebook was not the only social network available. These platforms did not require

huge amounts of data, as they initially had limited data available. In China, the history of platforms has been different, with platforms like Tencent and Alibaba (Galloway, 2017: 206-210) benefiting significantly from the restrictive regulation of the Chinese Internet (cf. Jiang, 2012), which prevented access to many foreign platforms. Nevertheless, the market entry of online platforms has often led to innovations that have intensified competition in a healthy way, benefiting consumers with a more diverse selection, comparison options, and communication and networking options.

During the late 1990s and early 2000s, the New Economy surfaced, as fledgling technology enterprises were granted venture capital to conceptualize innovative business models that revolved around the monetization of the Internet (Thiel/Masters, 2014: 7). This disrupted the classic business models of the Old Economy, but many companies failed, except for some like Amazon (Galloway, 2017: 13-62), and PayPal, which established themselves sustainably. Amazon disrupted the classic book trade and built the Marketplace, which allows third-party providers to trade new or second-hand products. PayPal became the leading payment service on the Internet (Thiel/Masters, 2015). This disruption of classic business models led to the emergence of digital platforms, which today dominate the economy (Galloway, 2017: 2-7; Keese, 2016: 107-119). The dominant status of these technology firms is attributable to their extensive user base and worldwide data, resulting in an overwhelming market dominance. This has caused them to overtake conventional industries in market capitalization within a relatively brief period (Paul, 2018: 600-608). Entrepreneurs now face the challenge of adapting to the digital age or facing the risk of creative destruction (Reinert/Reinert, 2006: 55-85; Pfarrer/Smith, 2015: 1-3), which is the essential feature of market economies described by economist Schumpeter (1939). Unlike in the past, the platform economy is not just a technological innovation, but a complete disruption of traditional models, for which strategies and experience are limited (cf. Jaekel, 2020). This aligns with the concept of the innovator's dilemma, where even companies that do everything right can fail if they underestimate the strategic danger of disruptive innovations, as described by Clayton M. Christensen in 1997.

The digital economy is a crucial part of the development process, affecting the performance of nations. The implementation of the digital economy has direct consequences for various areas, including productivity, development, and rationalizing state management. Achieving these objectives and unlocking the potential of new technologies leads to a digital transformation. This urgency has been further intensified in the current economic scenario after the 2007 crash (cf. Lybeck, 2011). Despite lacking a clear vision, the concept of digital transformation has become a medusa chant of the economy (Verhoef et al., 2021), with the unknown impact of digital transformation on economies and people's lives remaining a concern. While discussions about technology and its impact on society are not commonly held in public forums, they have led to various developments across different fields of study including engineering, philosophy, economics, communications, and sociology. Technology is an essential topic for

understanding society due to its complexity, unique manifestations, operational logic, development, and possibilities for framing its understanding.

The impact of technology on the digital platform economy has been multi-faceted, encompassing several key areas (cf. Verhoef et al., 2021). The emergence of digital platforms has led to the creation of new business models that harness their power to generate value for users. This impact has been one of the most noteworthy consequences. Platforms like Uber and Airbnb have transformed the transportation and accommodation industries, respectively, by providing a convenient and accessible means of accessing these services. Another significant impact of technology on the digital platform economy has been the development of sophisticated data analytics tools. These tools enable businesses to collect and analyze vast amounts of data about their users' behavior and preferences, allowing them to optimize their operations and improve the overall user experience. Platforms like Amazon and Netflix use data analytics to personalize product recommendations and improve customer retention. Machine learning (ML), as well as Artificial intelligence (AI) are also playing an increasingly meaningful part in the digital platform economy, as these are being utilized to automate many aspects of key platform operations (e.g., customer service and support, or product recommendations). This has not only improved the efficiency and scalability of digital platforms but has also reduced operational costs, allowing businesses to offer more competitive pricing to users.

This study refers to digital platforms such as Alphabet, Meta, Microsoft, Apple, and Amazon (cf. Galloway, 2017), which have gained significant power in the digital ecosystem (Barabási, 2011; Parker et al., 2016). These platforms are a concern for various economic agents, governments, and organizations, which have recognized their centrality in society. Digital platforms connect various sides for the exchange of services (e.g., buying products on eBay or downloading apps on the Apple Store), social interaction (e.g., Snapchat or TikTok, cf. Miltsov, 2022: 664-676), or other activities (e.g., finding accommodations on Airbnb). A survey (Evans/Gawer, 2016) examined 176 digital platforms, which were worth a total of $4.3t and employed 1.3b people. These platforms have become essential to the digital economy because of their use of efficient technology, superior competitive strategies, and network effects. However, their success is also due to providing solutions that are valued by users. These platforms are highly valuable, with the most valuable companies being in the technology sector, according to Forbes' (n.d.) World's Most Valuable Brands in the World ranking: Apple (with a Brand Value of $241.2b and a Brand Revenue of $260.2b), Google ($207.5b/$145.6b), Microsoft ($162.9b/$125.8b), Amazon ($135.4b/$260.5b) and Facebook ($70.3b/$49.7b).

These companies have become attractive targets for investment. Digital platforms are a dynamic part of the current digital transformation, but they also face criticism from various places, be it in relation to displaying hate speech and discriminatory searches, or for promoting radicalization by featuring conspiracy theories. They have become a crucial part of not only the economy but society, as recognized by various sources (cf.

e.g., Parker et al., 2016: 5-7; Galloway, 2017: 1-12). The importance of these platforms extends beyond their reach to billions of users and their market valuation worth billions of dollars, as they also pose risks to different areas of society. For instance, they can impact politics by influencing public debate and spreading disinformation. Culturally, they can facilitate hate speech and discrimination against minorities or different individuals and groups. They can also affect society by increasing consumption, which some studies have linked to declining well-being (e.g., Bekalu et al., 2019: 69-80). Moreover, their ability to exploit their dominant market positions could lead to negative repercussions on the economy, particularly on the Internet. This investigation focuses on digital platforms due to their impact on these areas.

Given the significant impact of technology on the digital platform economy, it is crucial for economic research and business administration to investigate this topic comprehensively. Scholars can make valuable contributions to this field by investigating the catalysts that fuel innovation and expansion within the digital platform economy, as well as the repercussions of technology on market structures, consumer conduct, and business tactics. Furthermore, policy and regulators have a crucial responsibility to ensure that the digital platform economy offers are distributed, and that the possible risks and challenges are efficiently addressed. Platforms are complex items that are analyzed in various fields, such as law, society, communication, administration, and economics. This study is primarily centered on the economic perspective. The framework chosen for the analysis is technology as the success and scope of the platforms are directly related to their technical solutions. The services provided by these platforms are linked to tools and systems created by them, and the issues arising from the platforms are also connected to their technical resources. However, this framework does not mean that the investigation is limited only to the technical aspects of platforms. Instead, the investigation aims to look at the platforms articulating it with a wider, holistic view.

This research project was influenced by the fact that digital platforms have a dynamic relationship with the economy and its users and customers. Therefore, it is important to understand the broader context in which these platforms operate. These platforms are part of a larger digital ecosystem that is being transformed to respond to economic challenges. Problems associated with these platforms have a significant impact. This understanding is not original to this work, but it is essential to respond to the challenges posed by these platforms. The common perception of these platforms is that they are the result of the efforts of lone, brilliant developers. The swift expansion of platforms raised concerns about their rapid success and how they have achieved such widespread adoption in a short span. Consequently, the economic perspective presents a limitation since companies are constantly evolving and dynamic entities. Based on such references and the associated questions, this study has formulated a research problem that will be addressed by reviewing crucial technical components of digital platforms, conducting a comprehensive analysis regarding the impact of these components on the digital platform economy, and examining the consequences on

users downstream, supported by actual case studies and real-world examples. As such, the research aims to answer the following research questions:

- RQ 1: What are key technical components of digital platforms?
- RQ 2: How do these technical components impact the digital platform economy?

Although extensive, these research questions aim to condense the main objectives of the investigation. Additionally, this study has specific goals which are: 1) to determine the technological setup that served as the foundation for platform development; 2) to outline components and resources; 3) to comprehend key economic aspects that are facilitated by these, such as market structure, ecosystems, or concentration; and 4) to evaluate their impact on users by understanding e.g., legislation, intervention, terms of service and employment in the digital platform space. To achieve this goal, the study begins by reviewing economic theories and introducing the approach of analysis. The framework suggested seeks to understand platforms as a process shaped by external and internal factors. These platforms are analyzed as providers of applications and services in a competitive environment, and their operating logic determines the ways of usage of these.

The investigation is structured into chapters. Chapter 2 (Economic Theory on Digital Platforms) serves as the starting point and features an extensive discussion that centers on theories in literature pertaining to platforms and their dynamics within the technology framework. The chapter commences with an overview of essential economic theories that underpin the digital platform economy, such as platform traits, innovation, disruption, and competition theory.

Chapter 3 (Analysis Approach) outlines the approach taken in the research, by examining the role of technology, using the critical theory of technology (CTT) as a framework. The CTT is the reference model used for the review and analysis, and the study contextualizes platforms within economy by utilizing a set of references that guides the analytical effort throughout the investigation. The chapter further outlines the methodology used for the cases and sources of information used.

Chapter 4 (Technical Components of Digital Platforms) of the study narrows down key technical components of digital platforms. As such, the chapter exposes constituting elements such as protocols and standards, network infrastructure and connectivity, CPUs, mobile devices, applications and application programming interfaces, data collection, blockchain, algorithms, artificial intelligence and machine learning, augmented reality, virtual reality, and related developments towards the possible creation of a metaverse.

Chapter 5 (Technological Impact on the Digital Platform Economy) then focuses on a comprehensive analysis of the impact of these technologies on the economic environment in which platforms operate. The chapter distinguishes distinctive aspects and impacts, such as significant market shares within various areas, multi-sided markets,

network effects, value exchange, scaling and scalability, data collection and exploitation, ecosystems, and concentration. In addition, the chapter presents an analysis of the impact of platforms on their users regarding legislation, legal and regulatory intervention, and platforms' terms of service and the future of work. This chapter consolidates the technical review, the economic impact analysis, and the analysis of impact on users of digital platforms and constitutes the main chapter of this study. Throughout the analysis, case studies are being used to provide real-world examples of how technological impact, economic theory and market dynamics play out in practice. The findings of the analysis are synthesized in chapter 6 (Summary) to provide a holistic view.

The advent of technology has revolutionized the global economy and brought about a paradigm shift in the way businesses operate. The digital platform economy is an exemplary field where technology has produced a considerable influence, altered conventional business models, and opened fresh avenues for expansion and advancement. The digital platform economy refers to the collection of digital technologies and platforms that facilitate the exchange of goods, services, and information in a networked environment. The emergence of new business models that harness the potency of digital platforms to generate value for users is among the most noteworthy impacts of technology on the digital platform economy.

The rise of platforms like Uber, Airbnb, and Amazon has disrupted traditional industries and transformed the way people access goods and services. These platforms have created new opportunities for entrepreneurs and small businesses to reach a wider audience, driving economic growth and innovation. Technology has also enabled the creation of advanced data analytics tools that enable businesses to amass and scrutinize massive amounts of data about their users' conduct and inclinations. This data can be leveraged to refine product design, marketing tactics, and pricing models, enhancing the user experience as a whole and creating fresh revenue streams for businesses. Additionally, another noteworthy effect of technology on the digital platform economy is the emergence of machine learning and artificial intelligence. These technologies are being used to automate many aspects of platform operations, from customer service and support to product recommendations and fraud detection. This has not only improved efficiency and scalability of digital platforms but has also reduced operational costs, allowing businesses to offer more competitive pricing.

However, the impact of technology on the digital platform economy is not without its challenges. One of the biggest concerns is the increasing concentration of market power in the hands of a few dominant platforms. This concentration can limit competition, reduce innovation, and ultimately harm consumers' interests. Additionally, there are concerns about the impact of automation on employment and the potential for technology to exacerbate existing inequalities in society. In conclusion, the impact of technology on the digital platform economy has been significant, creating new business models, driving innovation, and improving the overall user experience. However, it is

important for policymakers and regulators to be mindful of the potential risks and challenges associated with the increasing concentration of market power and the impact of automation on work and employment.

While there are challenges associated with this transformation, the benefits of the digital platform economy are undeniable. Therefore, it is crucial for economic research and business administration to investigate this topic comprehensively to ensure sustainable and equitable growth in the modern economy. The aim of this study is to enrich the domain of economy and technology research by offering a more profound comprehension of digital platforms. Using a set of references as a guiding principle and analysis approach, the study highlights the importance of internal and external factors and development context in analyzing platforms. The analysis emphasizes the significance of considering multidisciplinary aspects to comprehend the recent development of digital platforms, including the design of their setup, characteristics, and operating logic. The study proposes an approach that emphasizes the importance of considering multiple point of views of the economy when analyzing platforms and their technological components, highlighting the relevance of economic and cultural factors. By doing so, the study provides a conceptualization of digital platforms and their operating logic with a goal to enrich the conceptual instrument for technology studies and contribute to an accurate understanding of digital platforms and their inherent technological features.

2 ECONOMIC THEORY ON DIGITAL PLATFORMS

2.1 Characterization, Definitions and Types of Platforms, Their Development and Operations

2.1.1 Characterization and Definitions of Platforms

Platforms are digital infrastructures that enable interactions and transactions between different groups of users. They are often characterized by their ability to bring together buyers and sellers, service providers and customers, or creators and consumers in a digital environment. Platforms have become a ubiquitous feature of the digital economy and are used to create new business models, disrupt traditional industries, and enable new forms of innovation. In today's economic environment, platforms have evolved into successful systems with substantial technological, economic, and social implications that hold a crucial position in our world. American and Chinese giants like Meta, Amazon, Alibaba, and ByteDance introduced platforms in the business-to-consumer sector, driving the digital transformation of industries.

Network effects are one of the fundamental characteristics of platforms. They describe a phenomenon where the value of a platform rises as more users engage in its activities and join the platform. This creates a virtuous cycle where more users attract more users, and the platform becomes increasingly valuable over time. Platforms can be identified as multi-sided markets that connect various sets of users who obtain benefits from engaging with one another on the platform. The term multi-sided markets implies that platforms serve as intermediaries, bringing together various groups of users, such as sellers and buyers, who can interact with one another, creating value and generating benefits. These platforms create value (McGee, 2014b: 1-4) by connecting people and organizations who might not have met, in a simple, fast, and often free manner for consumers. Innovation platforms play a crucial role as open technology kits where companies of all sizes, institutions, and individuals can innovate. Platforms are technological enablers for innovation and added value, opening a pool of external developers, and contributing to innovative, digital ecosystems.

The success of a platform heavily relies on its design, which must be developed with careful consideration of various factors such as usability, scalability, and security. Usability refers to how easy and intuitive the platform is to use, while scalability refers to the platform's ability to handle increasing numbers of users and transactions. Security is also crucial, as platforms must protect user data and prevent unauthorized access to the platform. Regulatory issues surrounding platforms are complex and often contentious. Policymakers, therefore, must balance concerns around competition, data privacy, and consumer protection when regulating platforms. Platforms can give rise to concerns about monopolistic behavior, as network effects can make it difficult for new entrants to compete with established players. Data privacy is also a concern, as platforms often collect and use vast amounts of user data. Platforms have the potential to bring about both favorable and unfavorable effects. While they can facilitate novel types of business ventures and creativity, give rise to additional markets, and generate

fresh economic prospects, they can also have negative impacts by facilitating harmful or illegal activities, exacerbate inequality, and concentrate power in the hands of a few large players. A responsible approach to platform development and governance is essential to ensure that platforms promote equitable access to the benefits of platform participation.

There are various definitions of platforms in the literature, reflecting the variety of ways in which platforms are conceptualized and studied. Overall, platforms are commonly characterized as digital infrastructures that enable interactions between multiple groups or stakeholders, creating and exchanging value through network effects complementary services, or data-driven feedback loops. Research on platforms focuses on their distinctive business models, structures of governance, and approaches to innovation, as well as their effects on various industries, markets, and society. Gawer (2014: 1240-1248) suggests a distinct approach for defining platforms, which emphasizes their organizational integration instead of focusing only on technical or economic aspects. The author (2014: 1240) identifies technological platforms as organizations that connect parties who can innovate and compete, create, utilize economies of scope, and possess a technological structure with core and periphery. According to Parker et al. (2016: 11) a platform is a digital business model that creates value by facilitating exchanges between two or more interdependent groups, usually consumers and producers or service providers. Platforms provide a foundation for multiple participants to connect, share resources, and interact with one another, often using data-driven algorithms.

A platform's success hinges on its capacity to produce network effects, establish positive feedback loops, and allow its users to co-create value (McGee, 2014b: 1-4). Evans/Schmalensee (2016) describe matchmakers as companies that facilitate connections between individuals looking to sell or offer a product / service with those who have a demand or desire to consume it. Unlike traditional firms that create and sell products, matchmakers sell access to one group to another, with demand becoming a crucial factor in their market and pricing structure. The success of matchmakers is heavily influenced by network effects, which are generated through the participation of users in the platform or service. As matchmakers depend on users as their primary source, network effects are crucial for their success. The authors emphasize that the matchmaker model revolves around establishing connections between two or more parties and their monetization. Digital platforms create a demand economy monetizing services previously offered privately.

2.1.2 Classification of Existing Platform Types

Platforms are digital infrastructures that enable interactions and transactions between different groups of users. Platforms are distinguished by their capacity to unite vendors and buyers, clients and service providers, or producers and consumers in a digital setting. There are several ways to delimit platforms, and different scholars and

experts use different terms and concepts to describe them. While classifying digital platforms into various types can help to comprehend their operations, it's crucial to note that there may be some overlap between the categories. For example, a platform operator may also act as a dealer, and traditional industrial companies may create their own exclusive platforms. Despite this, there are significant distinctions between digital platforms and traditional companies regarding value creation (McGee, 2014b: 1-4).

Traditional firms usually work in a sequential value chain, beginning with raw materials and ending with finished products, emphasizing customer satisfaction. Such businesses are frequently labeled pipeline companies (Parker et al., 2017:17) and operate in pipeline markets. Digital platforms, on the other hand, create digital ecosystems and operate asset-light business models, with a focus on both customers and providers in a two-sided or multi-sided market. Instead of optimizing their production processes, digital platforms focus on the matching algorithm to connect providers and customers in a frictionless way. This approach enables them to scale more quickly, with lower costs and risk, and to achieve critical mass. As a result, digital platforms are managed differently from traditional companies, with key platform indicators such as daily or monthly active users, growth rates, successful interactions, engagement, and matching quality of the search algorithm (cf. Parker et al., 2017: 187) being more important than traditional metrics such as cash flow or profit margins. Understanding platforms as a type of system requires recognizing their diversity. Since digital platforms operate in various activities, it's useful to have a typology to organize analyses on specific fields within the complex platform universe.

Parker and colleagues (2016) suggest a classification of platforms in their work Platform Revolution: 1) Aggregation Platforms: these platforms generate value by facilitating connections between numerous producers and consumers. They facilitate transactions between these groups and benefit from network effects that make their platform more valuable as more people use it. Examples of aggregation platforms include Uber, Airbnb, and Amazon (Galloway, 2017: 13-62, 214-220). 2) Social Platforms: these platforms facilitate the creation and distribution of user-generated content, as well as social networking and community building among their users. They create value by facilitating social interactions and allowing users to express themselves (e.g., Instagram, and TikTok, cf. Miltsov, 2022: 664-676). 3) Mobilization Platforms: these platforms help users organize and coordinate activities, such as political or social movements, and create value (McGee, 2014b: 1-4) by providing a means for individuals to collectively act and achieve a common goal (e.g., Kickstarter, Change.org, and GitHub). The authors acknowledge that several platforms can fit into several categories, and the distinctions between them are sometimes ambiguous. Nonetheless, understanding these platform types help businesses and entrepreneurs to identify the key value propositions of different platforms and build successful platform businesses.

According to Evans/Gawer (2016; cf. Cusumano et al., 2019), platforms can be categorized into transaction platforms, such as online payment services, exchange services, or agency services, and innovation platforms, which are the basis for other

businesses to develop complementary technologies or services. The authors also identify integrated platforms, which function as both transaction and innovation platforms. Lastly, they mention investment platforms, which act as holding companies, platform investors, or both, and operate on a different logic compared to the other platform types. A widely used characterization of platforms is that they are digital models for business that generate value by facilitating interactions between two or more interrelated groups of users, usually producers or service providers and consumers. Platforms serve as a basis for several actors to connect, exchange resources, and engage with each other, often relying on algorithms. Another way to define platforms is by their structure. Platforms are typically characterized by their openness, modularity, and interoperability (cf. Hodapp/Hanelt, 2022). Openness refers to the platform's ability to support third-party developers and users who create and share complementary products / services. Modularity refers to the platform's ability to be easily modified and adapted to different user needs and preferences. Interoperability refers to the platform's ability to integrate with other platforms and systems, creating a network of interconnected platforms that enable seamless exchanges of data and services (Kerber/Schweitzer, 2017: 39-54; Diallo et al. 2011: 84-91).

Platforms can be also considered based on their activities (Wirtz et al., 2019: 452-483). Digital social networks allow users to connect with others for online-based communication, where social networks place advertisements by third parties to earn income and offer their services for free to customers, while others are partially financed through paid memberships, with little or no additional advertising funding involved. Content & Review platforms generate their income through advertising targeted to user preferences based on their behavior. When users enter certain search terms, search engines display links to websites of other content providers. Search platforms utilize algorithms to determine most relevant search results based on criteria such as clicks and links from other websites. The search algorithm collects and analyzes data from user behavior, allowing to better align search results with users' interests and expectations. Website providers can place ads for predefined search words, the advertisement appears alongside the original and vertical search results.

2.1.3 Platform Development and How They Differ From Classic Businesses

The purpose of the modern platforms, as indicated, is the ability to add value (McGee, 2014b: 1-4), for which they combine the technological basis, rules, and participants via a new organizational principle. Currently, many of these still resemble platforms frequently described as web 2.0 platforms (Murugesan, 2007: 34-41) or simply as social networks when they first entered the market, but which have already replaced these predecessors in terms of their market importance. The approach to implementing a strategic project in the digital economy and setting up a digital start-up may vary significantly depending on the circumstances, but the theory of constraints (TOC; Goldratt/Cox, 2014; Kalender et al. 2014: 930-936) can be used to explain it. This theory focuses on identifying and addressing constraints and bottlenecks that limit

the achievement of goals in a system that is designed to achieve those goals. It assumes that there is a minimum of constraint that limits the performance of the system and aims to find ways to alleviate it to improve overall performance. The theory assumes that a goal can be articulated and measured. To get there, it's important to understand strengths of an enterprise, define them, and pursue the resulting benefits depending on the automation of the business process, along with the identification of a digital vision.

Consistent with this is that the digital platforms should have a pronounced technological competence. Digital platforms, as two- or multi-sided markets, do not have one classic target group, but several different target groups instead. The target group dialogue must therefore be expanded, and the benefits for all those involved in the ecosystem must be formulated. It is important that the potential benefits of the interaction partners are equally distributed, otherwise the digital platform will not be attractive enough. Hereby, in some cases, the target group dialog mentioned can also be automated. When digital platforms test new functions, they often perform so-called A/B testing (Beasley, 2013: 201-207), in which the target group is divided into a group A and group B. One group of users access the original online experiences, while the other group experiences the changed or updated functionality. The success of the measure can then be determined automatically after a short time and a decision can be made as to whether the function is going to be implemented or not.

To establish a new digital platform, three key success factors must be coordinated (Jaekel, 2020: 64): Pull effects shall attract customers to the platform and to maintain their interest. A simple interaction via the user interface without barriers must be guaranteed so that the interaction exchange for the partners is simple, such as uploading a photo using the Facebook app on the smartphone. Matching secures an efficient exchange of services / goods between partners in matching platforms requires extensive use of data, filters, and search algorithms, among other techniques. Curation is a central task for the platform operator, curation allows for filtering the activities of the interacting partners, i.e., the behavioral patterns on the platform as well as the actual content. This represents a central measure of quality and risk management to avoid negative network effects.

Subsequently, according to Gawer/Cusumano (2014: 408-421), an innovation strategy is developed and managed that represents an improvement in performance in an existing constraint or bottleneck for the target group. However, with digital platforms the innovation can't necessarily be based on a bottleneck that got expressed in the dialogue with a target group as the type of change or innovation can be so significant that one speaks of disruption, which in turn might result in changed customer needs. As such, in the case of digital platforms, the innovation strategy often means dealing with a cooperation strategy through which other partners are synergistically integrated into the ecosystem. Digital platforms do not aim to offer all services in the ecosystem on their own. Instead, they form partnerships while maintaining control over digital processes to continually benefit from the generated data and the ability to switch

partners whenever necessary to safeguard the long-term corporate strategy and meet the basic needs of target groups. Dominant digital platforms fulfill this task of coordinating the needs of providers and consumers and, while gaining knowledge through data analysis, make this coordination process more precise.

The active, planned creation of platforms is difficult (cf. Parker et al., 2016: 55). Companies must make far-reaching decisions in situations of great uncertainty, as when considering a market there is usually little information available on whether the market is ready for platform design and related success. In addition, building such platforms is not part of the standard strategic repertoire of companies as they are not being built regularly, but rather rarely (Gawer, 2012: 317). The role of individuals in reshaping an industry should not be underestimated, as they have the potential to bring significant changes. Hereby, practical experience in the industry seems to play a role. It is also clear that strategies for building platforms differ significantly from pipeline strategies of the traditional businesses, especially regarding of the respective ecosystem. Looking at the usual actors involved in digital platforms, classic platform entrepreneurs are identifiable who can deliver the essential core technology, arrange the ecosystem, and successfully launch the platform quickly in a short period of time. Examples include the cases of e.g., Facebook, Amazon, Google, or as well eBay.

Another form of platform players is the concerted approach, which involves the dedicated cooperation of various companies towards the common goal of establishing a digital platform. Following that, an important question is whether entrepreneurs or consortia are more successful platform drivers as matters such as the dominance of individual platform operators and possible monopoly building are being discussed broadly. It can be assumed that entrepreneurs can act faster and organize a platform more stringently, while, in contrast, consortia are likely to be particularly strong when there are many unknown variables in the market and where no single player can overcome these market complexities and uncertainties. There may also be advantages in building the ecosystem since more actors with different interests are involved in the design process (Gawer, 2012: 273-299). Either way, platforms are not static, but continue to evolve in very different ways. In one way, according to Eisenmann et al. (2008: 149), the boundary between the core and the ecosystem can shift within platforms as functionalities that were originally offered in the periphery are integrated into the core of the platform (envelopment). Also, platforms that are under pressure due to new technological developments tend to open with the aim of increasing the attractiveness of the platform for the ecosystem. Lastly, platforms can also become redundant and detached as a matter of technological change.

In that sense, platforms overall are different from classic businesses in several ways. Platforms create value (McGee, 2014b: 1-4) through the facilitation of interactions and transactions among multiple participants, whereas traditional businesses generate value by producing and selling services / goods. In other words, platforms are marketplaces that facilitate exchanges between buyers and sellers, service providers and customers, or creators and consumers, while classic businesses are typically

producers or providers of goods or services. Second, platforms are characterized by their ability to generate network effects, which occur when the value of a platform increases as more users join and participate in the platform's activities. This creates a virtuous cycle where more users attract more users, and the platform becomes increasingly valuable over time. Classic businesses do not typically exhibit network effects, as the value of their goods / services does not necessarily increase as more customers purchase them. Third, platforms are more flexible and adaptable than classic businesses. Platforms can be modified and updated to meet changing needs and preferences of their users.

In contrast to platforms, traditional businesses face limitations due to their current infrastructure, production methods, or product offerings, which can make it challenging to respond to shifting market demands. Another key difference is that platforms have a strong ability to use data and algorithms to generate value (McGee, 2014b: 1-4). Platforms collect significant amounts of data on user behavior and preferences, which can be leveraged to enhance the platform's functionality, personalize user experiences, and spur innovation. While traditional businesses may also collect data, they generally do not possess the same level of data-driven capabilities as platforms. Finally, platforms are often characterized by their ability to support third-party developers and users who create and share complementary products / services. Classic businesses may also have partners and suppliers but are typically more hierarchical and centralized in their relationships with other actors in the ecosystem.

2.1.4 Modes of Operation, Differentiation, and Interoperability

The use of multiple digital platforms simultaneously, known as multihoming (Sousa et al., 2013: 285-365; cf. Evans et al., 2016; Shin et al., 2005: 543-548), is an essential factor to consider when analyzing digital platforms due to its impact on competition and user behavior. The technological foundation of digital platforms is crucial for their competitiveness and survival, distinguishing them from other types of intermediaries. Digital platform companies often use differentiation as a key strategy, which can take various forms such as offering unique products / services. Differentiation can also include features or conditions that provide better or more qualified performance than competitors. Digital platforms have a competitive advantage due to their technological nature and differentiation, which motivates companies to pursue innovation. The commitment to innovation is apparent from the company's early days and persists even as the company attracts investments. Startups emerge offering solutions to various issues, reflecting the quest for differentiation and innovation. As a service gains traction, it generates an innovation movement that illuminates demand previously overlooked. This leads to the entry of new players into the market, creating a competitive environment that fosters innovation and differentiation.

In the world of digital platforms, innovation is a key factor in distinguishing oneself from competitors and attracting users, particularly in cases where there is no clear

market leader. Innovative products / services can lead to substantial profits for companies. Even established market leaders continue to prioritize innovation and frequently test new features and improvements. For free platforms, innovation is necessary to expand the user base and prevent user attrition. Companies can use innovation to prevent competition by introducing new features, such as Instagram's story format, which was added after Snapchat's popularity. However, not all new technology or products are successful, and companies may establish exclusive control over technological resources to prevent competitors from entering the market. Patents can help establish control but can hinder the development of competing solutions.

When examining digital platforms, it is important and critical to also consider the concept of interoperability (Diallo et al. 2011: 84-91; Hodapp/Hanelt, 2022; Kerber/Schweitzer, 2017: 39-54). This term pertains to the capability of distinct services to collaborate and share information with one another. Interoperability can be categorized into horizontal and vertical, where vertical interoperability is vital to ensure that complementary services are compatible with the platform. In other words, applications should be interoperable with the OS. Companies aim to provide an ecosystem with the most extensive functionality, which encourages vertical interoperability (Kerber/Schweitzer, 2017: 4). Horizontal interoperability is referring to the capability of different platforms to interact and exchange data with each other, while vertical interoperability enables complementary services to be interoperable within a platform system. The incentives for allowing interoperability are less significant for competing platforms, but standards need to be established for different services to work together (Kerber/Schweitzer, 2017: 5). Real-time portability is another aspect that requires a certain degree of interoperability, but the flow of data usually goes from the dominant platform to the competitor or other partner, as opposed to going the opposite way. To allow two or more services to function as viable substitutes, more extensive integration and standardization are needed.

From a competition policy viewpoint, this is beneficial as network effects would no longer be exclusive to one platform, but extend to all rivals, and it would not matter which login is used for multiple social networks or owned and operated platforms. However, Kerber/Schweitzer (2017: 15, 21) argue that while interoperability has a positive effect on preventing lock-in effects and enhancing competition, it also has significant drawbacks. Allowing mandatory access to a platform's system for other services could raise concerns about security and data protection. Platforms like Apple iOS operate on a closed architecture, which allows for better control of available applications. Complete interoperability through service standardization may limit product differentiation (Galloway, 2017: 184-188) because the diverse and constantly evolving services offered make it challenging to define a standard. Furthermore, once a standard is developed, there would be limited opportunities for deviation, hindering innovation and competition between different systems (Kerber/Schweitzer, 2017: 39-54). While interoperability can prevent lock-in effects and strengthen competition, the potential benefits of

interoperability must be weighed against the risks of standardization and regulatory monitoring that could hamper innovation (cf. Diallo et al. 2011: 84-91).

2.2 Role, Terminology, Definitions, Classification, and Impact of Innovation

2.2.1 Innovation and its Role in the Digital Platform Economy

Nowadays, innovation is a crucial factor that impacts the competitiveness overall and is a decisive element for the growth of all organizations that are actors within a competitive setting. As such, innovation is also essential for the digital platform economy to continue to grow and develop. New technologies, business models, and approaches emerge regularly, and without innovation, enterprises risk being left behind. Comprehending the theories outlined in this chapter that form the basis of the digital platform economy can assist individuals and organizations in remaining at the forefront and predicting forthcoming transformations. These theories can explain how technologies and business models have evolved and what factors have contributed to their success or failure. Innovation in the digital platform economy is not only important for individual companies but also for the broader economy. Digital platforms have the potential to create new jobs, increase productivity, and stimulate economic growth. However, they also raise important social and ethical concerns, such as data privacy, algorithmic bias (cf. Aysolmaz et al., 2020), and platform monopoly power. Comprehending these topics via academic theories can also aid policymakers in devising efficient regulations and guaranteeing that the advantages of digital platforms are distributed more extensively. By keeping abreast of the most recent developments and comprehending the fundamental theories, individuals and organizations can persist in prospering in this lively and fast-paced milieu.

Innovation in the digital platform economy has a rich and complex history, spanning several decades of technological advancement and creative ingenuity. The birth of the World Wide Web in the 1990s was a pioneering example of digital platform innovation, which created new or additional opportunities for online communication and information sharing. This set the stage for the growth of search engines such as e.g., Yahoo, which transformed the way people searched for and accessed information on the internet. The early 2000s then saw the emergence of social media platforms (e.g., Myspace, Facebook, Twitter, or Instagram) which allowed users to connect and share their content with each other on an unparalleled level. These platforms also gave rise to new forms of digital advertising and marketing, which became essential tools for businesses looking to reach new audiences online. In the mid-2000s, the introduction of smartphones led to a wave of innovation in the digital platform economy.

The evolution of the digital platform economy continued with the emergence of mobile apps, enabling users to access various services and content directly from their devices. This, in turn, facilitated the growth of the sharing economy (cf. Agarwal/Steinmetz, 2019; Hamari et al., 2016: 2047-2059; Schor et al., 2015: 12-19), exemplified by companies like e.g., Uber (cf. Dudley et al., 2017) and Airbnb (Hijrah Hati et al. 2021;

Núñez-Tabales et al. 2020; Oskam/Boswijk, 2015: 22-42), which utilized digital platforms to provide ride-sharing and short-term rental services, respectively. Nowadays, the developments toward AI/ML technologies have opened new possibilities for innovation in the digital platform economy. These technologies are being used to develop more sophisticated algorithms and personalized user experiences, as well as new forms of automation and predictive analytics. Other notable innovations in the digital platform economy include the rise of blockchain and cryptocurrencies, which are potentially enabling novel means of digital payments and finance-related transactions, along with the emergence of AR/VR, which are creating new possibilities for immersive and interactive digital experiences. As such, the history of innovation in the digital platform economy is characterized by a dynamic interplay between innovative technological advancement, creative ingenuity, and shifting user behaviors and expectations.

2.2.2 Approaches Towards Innovation in Literature

Decades before the concept of innovation became a standard issue in almost all companies and a frequently cited phrase in most corporate statements or company presentations, Schumpeter (1934) developed his core idea of a state of constant disorder and that is moving due to innovative ideas by creative entrepreneurs, which provokes progress and growth. Today, the concept of creative destruction (cf. Reinert/Reinert, 2006: 55-85; Pfarrer/Smith, 2015: 1-3) has more relevance than ever, as innovation became a central theme for almost every organization. In times of constant change, size is not the one and only most relevant criterion for the strength of a company, it is rather the adaptability to changing conditions in their respective competitive economic landscape. According to Arnold (2012), organizations today are maintaining their stability through constant evolvement. All rules, systems, processes, products, services, will eventually have served their purpose and will need to be renewed over time - otherwise they are prone to replacement. Consequently, for organizations, innovation is a source of economic growth, industrial development, and advantages in terms of ability to compete (cf. Damanpour et al., 2009: 650-675).

In an economy where companies aim to increase growth and sustainability, it is a key element for companies to move towards creating and processing innovation, since otherwise companies run the risk of being outperformed by others that lead in terms of changes in their offerings, operational processes, or business models (Tidd/Bessant, 2013). Therefore, in a competitive environment, a lack of innovation can become a significant issue. This is often due to inadequate investment in R&D, a limited range of products that target consumers with low purchasing power, challenges in identifying technological opportunities in established markets, failure to recognize emerging markets, difficulties in designing business models that provide more value to customers, and organizational resistance to change.

The global market is characterized by profound social, economic, and technological changes, innovation being a facilitator in adaptation processes. Innovation is important

in economic growth, in the competitiveness of industries and companies and in the improvement of expectations and quality of life (Gopalakrishnan/Damanpour, 1997: 15-28; Porter, 1990: 73-93); and has, therefore, been the focus of research in various related fields (e.g., economics, or as well sociology) (Gopalakrishnan/Damanpour, 1997: 15-28; Subramanian/Nilakanta, 1996: 631-647). According to latter duo, researchers in business administration have been interested in this area, and two main schools in innovation research have been identified: the first - with background in marketing - focuses on understanding the causes of innovative consumer behavior. The unit of analysis is the individual consumer, and this school focuses on identifying the characteristics and behavior of innovative consumers to improve the effectiveness of marketing strategies. In the second - with background in organizational theory and strategic management - the organization is the unit of analysis, and the interest is focused on the characteristics of an innovative organization.

Literature on innovation is abundant and approached from different aspects, but two important currents stand out: the first, theories of the types of innovation (typologies, dimensions, and impact) and the second, the diffusion of innovation, which is responsible for the extension of innovations in markets. The focus of this chapter corresponds to the first stream. In this chapter, some approaches to the delimitation of innovation are considered and different types, as well as their dimensions are reviewed from three perspectives of measurement of impact: organizational, technological, and by taking the market perspective. This and following chapters emphasize the correlation between organizational performance and innovation. They assess innovation's definition from multiple authors, scrutinize various types of innovation, examine the innovation's location, determine the relevant units of analysis, and are fortified by an all-encompassing approach integrating several classifications identified in literature.

Companies are increasingly immersed in a globalized world in which competition is constant (Dereli, 2015: 1365-1370), where markets change rapidly, where resources are scarce, and in which consumers demand products with high standards of quality and service, the capacity for innovation is a valid medium or even an existential capability as organizations adapt to these volatile conditions (cf., e.g., Calantone et al., 2002: 515-524; Damanpour et al., 2009: 650-675). The relationship between the company's capacity for innovation and performance is fundamental in creating value (McGee, 2014b: 1-4). Therefore, innovation, today just as in past times, is a meaningful factor in long-term performance as well as sustained performance under dynamic and changing market conditions (Hatzikian, 2015: 749-768; OECD, 2005). Companies, as such, must be able to respond accordingly in a timely manner to these changes, innovating with new products and taking advantage of new market opportunities to survive. According to the study conducted by Garcia/Calantone (2002: 110-132), there is an observable correlation between a company's ability to innovate and its overall performance. They concluded that to achieve a competitive edge, companies need a deep understanding of their clients' needs, the competition, and how to align themselves with technological advancements. Klomp/Van Leeuwen (2010: 343-364) determined a

positive relationship between the innovation process and the general performance of companies, since innovation contributes to sales, productivity (sales per employee), and employment growth.

Consequently, Li/Calantone (1998: 13-29) found a clear relationship between product advantage and market performance (EBIDTA, ROI, profit before taxes and market share), which is supported by Roberts/Amit (2003: 118) when they affirm that firms that exhibit higher levels of innovative activity on a consistent basis generally have greater financial returns, further supporting the notion that innovation is positively associated with improved performance. Tidd/Bessant (2013) argue that while new products are perceived as the spearhead of innovation in the market, process innovation plays as an important role as the strategic one, adding that complexity and uncertainty of the environment affects the degree, type, organization, and management of innovation, as the more these factors are adjusted or the more coherent the configuration, the better the performance (Tidd, 2001: 180). Therefore, it is important to understand dynamics, types, characteristics, and processes involved in innovative activity.

2.2.3 New Combinations, Creative Destruction, and the Entrepreneur

The word innovation was originally derived from the Latin verb innovare, which means to renew. In the present day, innovation refers to the creation of new ideas and inventions and their application in the economy. The economic concept of innovation was first introduced by Schumpeter in his Theory of Economic Development (1934), which was initially released in 1912 and is widely regarded as one of the most impactful works in economics during the 20th century. In contrast to most economists who were mainly focused on the state of a market equilibrium, Schumpeter saw markets in imbalance and explained the dynamics of development by capitalism itself. Innovation, in Schumpeter's, divides into sociology and economics (2003: xv). While the first chapter of Schumpeter's work describes economic life as a static equilibrium or cycle which remains essentially the same for many years, it is the second chapter that deals with the phenomenon and the consequences of economic development, under which Schumpeter (2003: 70, 133) understands real innovations. Development herein is understood as a break-out of normal trajectories, as spontaneous and discontinuous changes that are not due to external impulses or resulting from quantitative changes. According to the author (1934), immaterial factors are forces of economic development that can develop a decisive and dynamic impact, and innovation is a part of such immaterial factors.

The description of nature and importance of entrepreneurial innovation as the enforcement of new combinations of production factors is considered the main thesis of the Theory of Economic Development (1934: 65). Following the author, the key role in economic dynamics is played by the pioneering dynamic entrepreneurs who are looking for new combinations and in implementing them even against resistance. Schumpeter (1934: 65) distinguishes 5 cases of new combinations: production of a new good

or a new quality of a specific good; introduction of a new production method or business models, opening or development of a new (sales) market; conquest of new sources of supply for raw materials or semi-finished products and reorganization of market positions (e.g., creation or suppression of a monopoly). The decisive factors are not the ideas and concepts themselves, but the implementation of the new combination of resources. The effective realization of a novel combination relies on three qualities. Firstly, a correct perspective or keen intuition concerning the matter is necessary, since there are no established data or rules of action available for something new; second, a certain inner freedom in combination with the energy to leave comfort zones and enter the unknown; and third, the ability to overcome resistances in different shapes and forms.

For Schumpeter (2003), it is explicitly not the mere status of ownership or the adoption of risk or the disposability of power that are crucial for being an entrepreneur and for the position as a leader, it is rather these skills and their impact on others. The entrepreneurial function is the basic phenomenon of any economic development. The new combinations created by such entrepreneurial spirit are later named innovations. They may be a different use of the stock of resources of the respective economy, which means that either other goods are being produced, or the existing goods are produced and/or distributed differently. Later, Schumpeter described these new combinations with the term creative destruction: processes which are replacing established practices (2003: 81). The term signifies that a new economic order replaces an old one, hereby referring to capitalism prevailing over the feudalist mode of production. Sombart (1913: 4, 207) sees creative destruction not only as the determining functional moment, but also that capitalism itself emerges from a process of increased creative destruction. In his work Krieg und Kapitalismus (1913), Sombart aims to prove that the always destructive war is most directly involved in the expansion of the capitalist economic system as war has created an important driving force of capitalist economic development with the development, financing, and training of modern armies as a market developer or creator. The terminology became known through the writings of Schumpeter, receiving a change in meaning to the extent that it now stands for positive economic characteristics of production, namely the capacity for innovation and technical or economic progress.

According to Schumpeter (2003: 156; 1934), only those who impose a new combination (i.e., an innovation) are entrepreneurs. The premium or the benefit for establishing the innovation is consequently the entrepreneurial profit. The innovative entrepreneur, in the beginning of his venture, achieves profit from the fact that, with the innovation, he's holding a de-facto monopoly (even if only over a limited period), which thereafter calls for imitators, so that the profit margin over time decreases, depending on the impact on competition. If the entrepreneur seeks to remain entrepreneurial and to hold his status, he is deemed to continue to search for new combinations. The capitalist plays a different role in the process, providing capital in the form of credit and receiving profit interest in return, which is because the actor who finances the operation

is the one who bears the financial risk. Schumpeter distinguishes the ordinary businessmen who trades in a traditional way and rather without inventing new combinations from the dynamic entrepreneur, and, as such, with average profit in comparison to existing competition. In describing the entrepreneur's motivation, Schumpeter uses psychological as opposed to classic economic categories: the dream and the will to start a venture, a profound will to win in combination with finding joy in creation drives the entrepreneur, as opposed to bare satisfaction of needs, calculation for personal benefits, or greed. Schumpeter emphasized that these relationships have a ripple effect on other factors such as credit and capital, entrepreneurial profit, surplus value, interest rates, and economic cycles. Additionally, he discusses the ascent and decline of the capitalist world as the central theme of one of his works (Schumpeter, 2003).

In brief, innovation in economics refers to a purposeful and focused process of moving towards something novel. However, in contemporary times, the term is used in other domains such as science and culture (cf. Reinert/Reinert, 2006: 55-85). The search for such new insights or the application of creative solutions equally require curiosity, creativity, and the desire for renewal. Historically innovations were frequently triggered by economic pressure, by the need for further development, or because of negative social conditions, and were, as such, caused by a state of comparative emergency. Innovations typically result from R&D and need to be differentiated from inventions (Bhasin, 2012). While inventions include both new ideas and prototyping or dedicated concept development in a pre-marketing phase, inventions can be named innovations in the economic sense once a need is recognized and a product, platform side, or business model is introduced or adopted accordingly.

As a result of that process, the benefits or a value of an innovation can be discovered only after a certain period, while at the beginning of the introduction the respective innovation may be perceived as rather obscure or even useless. The new product, procedure, or approach firstly requires meaningful interpretation or application in a market to unfold its potential in a real-life environment. Innovations necessarily must justify their own need and their own right to exist over time by being recognized and applied in an economic or social interaction. The process of creating does not suffice to justify the value of innovation - the innovation needs to proof itself in the field and be further enhanced through the interaction with users as these may see the value of an innovation in applications that weren’t part of the original intent (Svetlova, 2008: 175).

2.2.4 Definitions of Innovation in Literature

Definitions about innovation are abundant, from different perspectives and emphasizing different aspects and levels, as pointed out by Crossan/Apaydin (2010: 1154-1191) and Damanpour/Schneider (2006: 215-236). In the terms of Damanpour (1991: 556), an innovation is defined as the adoption of a device, system, policy, program, process, product, or service generated internally or purchased and that also is new for the organization adopting the innovation. Rogers (1962: 11) defines innovation as a

new practice, idea, or object. On the other hand, Garcia/Calantone (2002: 112) refer to the OECD definition and describe innovation as an iterative process that begins with identifying a new market or service opportunity based on technology, leading to development, production, and commercialization efforts aimed at achieving commercial success. The OECD (2005: 56) provides a definition of innovation that complements the previous ones, stating that it is the introduction of a new or significantly improved product, process, marketing method, or organizational method within a company or organization, including changes in internal practices, workplace organization, or external relations. For Damanpour/Schneider (2006: 216) instead, innovation is defined as an adaptation of a novel feature such as a service, process, technology, or structure.

Some common elements that arise from these concepts are novelty, implementation, and an iterative process. Novelty, in its most basic form, means something new that must involve knowledge, persuasion, or adoption decision (cf. Rogers, 1962: 172, 186, 217), and can be considered new for an individual, a group, an organization, an industry or for a complete society (Gopalakrishnan/Damanpour, 1997: 15-28). Adoption is a form of implementation and refers to the commercialization process of an innovation; in other words, an invention does not become an innovation until it has gone through a production and marketing process to be finally introduced to and disseminated in the market. A solution to a problem that leads to an invention and prototype but does not generate value for the organization cannot be called or referenced to as an innovation.

Therefore, an invention differs from an innovation in that the latter provides economic value by being disseminated and commercialized (Garcia/Calantone, 2002: 110-132; Gopalakrishnan/Damanpour, 1997: 15-28; OECD, 2005: 56; Robertson, 1967: 14-19). Another element in common is the establishment of the continuous evolution of innovation, which makes it iterative. Utterback/Abernathy (1975: 639-656) propose a model in which they point out that product development takes place with an initial emphasis on product performance, then focuses on its variety, with a final emphasis on standardization and cost reduction. The iterative process of innovation results in different types of innovation, such as radical innovations for new products in their early stages of diffusion and adoption, and incremental innovations for more advanced stages of the product life cycle, according to Garcia/Calantone (2002: 112).

2.2.5 Classification of Innovation Types and Characteristics

A classification of innovation types and characteristics is important for the understanding of the digital platform economy for three main reasons. In the digital economy, innovation plays a crucial role in driving platform success and provides a competitive edge to companies. Platforms are constantly innovating to create new value for users and stakeholders, stay ahead of competitors, and adapt to changing market conditions. Categorizing different types of innovation can aid researchers and practitioners in com-

prehending the various forms of innovation taking place in the digital platform economy, as well as the factors which are contributing to the possible success of platforms. Second, a classification can help to identify patterns and trends in platform innovation. Through the classification of innovation types based on their defining features, researchers and scholars can pinpoint the kinds of innovation that are pertinent to digital platforms and determine the factors that contribute to their triumph. This knowledge can then be utilized accordingly to guide business strategy and innovation initiatives within the digital platform economy. Third, it supports the development of a common language and framework for discussing and analyzing innovation in the digital platform economy to reduce confusion and ambiguity in the field of platform studies.

As such, innovation researchers have introduced multiple types, based on the characteristics or their degree of innovation (Damanpour et al., 2009; Garcia/Calantone, 2002: 110-132). However, academics generally define types of innovation based on their form (Crossan/Apaydin, 2010: 1154-1191). An innovation hereby can be a new product / service, a new production process technology, a new administrative structure / system, or a new plan / program relating to the members of the organization (Damanpour, 1991: 556). The OECD (2005: 58) established four types of innovation: product innovation, process innovation, marketing innovation, and organizational innovation. According to the OECD, product innovation corresponds to the introduction of a new good / service, or to a significant improvement in terms of its characteristics or its intended use. The improvement in characteristics can lead to the application of new technologies or to a new combination of existing ones, to significant improvements in technical characteristics, to the introduction of new materials, components and, lastly, to novelty in design that may lead to better product performance.

For Utterback/Abernathy (1975: 642), product innovation is a new technology or combination of technologies that is introduced commercially to satisfy the need of a user or a market, while Tidd/Bessant (2013:24) describe innovation in product as the process of making modifications to the services / goods that a company provides. Consequently, the focus of product innovation can be the creation of new products, improvement of the current characteristics, functionalities, or performance, as well as cost reduction or any other possible improvement (Moore, 2004: 86-92). According to Tidd/Bessant (2013: 24) process innovation is defined as a process that drives changes in the way products are being created and delivered. According to Utterback/Abernathy (1975: 641), this type of innovation is referred to as development, which involves continuous improvement of production processes. They define a production process as a system of equipment, workforce, work specifications, raw materials, and information flows used to manufacture services, or products.

The OECD defines process innovation as the implementation of a new or substantially improved method of production or distribution that involves changes in materials, techniques, and/or computer programs (OECD, 2005: 59). Improvements in input supply techniques, production and distribution, equipment, introduction of new or significantly improved information technologies are hereby aimed at optimizing resources

and skills and improving quality and productivity within an organization (Damanpour et al., 2009: 650-675; Moore, 2004: 86-92; OECD, 2005). Damanpour et al. (2009: 655) classify process innovation into technological process innovation and in innovation in administrative processes. Innovation in technological processes, according to the authors, are new elements in the production system of an organization, which modify the processes and operating systems through reduction in delivery times, improvement in the flexibility of the operation and reduction in production costs. Innovations in administrative processes involve the implementation of new methods to incentivize and recognize the efforts of members within an organization, aiming to restructure the strategy and design of tasks and modify the management processes of the organization.

Marketing innovation, according to the OECD (2005: 60), can be described as the application of a new marketing method that involves significant changes in the design or packaging of a product, its positioning, or its pricing. These changes help improve customer contact or consumer transaction processes (Moore, 2004: 86-92). Marketing innovation includes new methods of marketing new or existing products, significant changes in the appearance and shape of the product without modifying its functional characteristics, changes in product packaging, creation of new sales channels, new concepts for promotion and new pricing strategies. These items are being applied to better satisfy the needs of consumers, open new markets and achieve better brand positioning (OECD, 2005). To Francis/Bessant (2005: 180, 175), innovation in position is characterized by changes in the way a product is introduced, without altering its composition or functionality. Finally, organizational innovation is the introduction of a new organizational method in practice, the (re-)organization of the workplace or the external relations of the company (OECD, 2005: 62), which entails the implementation of a new technical or administrative idea that results in an organizational change and improves its performance in response to the uncertainty of the environment (Damanpour, 1991: 555-590). This concept in turn is related to the paradigm innovation that consists of the changes in the underlying models that frame the activities of a company (Francis/Bessant, 2005: 171-183; Tidd/Bessant, 2013). Organizational innovation in business practices involves the introduction of new methods for organizing work management routines and procedures, methods for distribution responsibilities and decision-making power among employees, new concepts of structuring and the way it relates to other companies or institutions (OECD, 2005).

The categorization of innovation types based on form is an important criterion according to the OECD (2005), and Damanpour/Evan's typification (1984: 392-409) is also significant in this regard due to the distinction that the authors make between the social and the technological structure, typifying the innovations as being of technical and administrative nature. Technical innovations do not only include the use of technology but are innovations that improve the performance of an organization's technological system (Gopalakrishnan/Damanpour, 1997: 15-28). According to Damanpour/Evan (1984: 394), a technical innovation can refer to the integration of a novel

idea for a product / service, as well as the integration of new components in an organization's production process or in the delivery of a service. Innovations that take place within the social systems of organizations are referred to as administrative innovations, i.e., they refer to the relationships between the people who interact to achieve expected results; system from which rules, roles, procedures, and structures emerge that can lead to innovations in management of human talent (Damanpour/Evan, 1984: 392-409). The literature highlights an existing relationship of innovation seen as a process and seen as a result (Crossan/Apaydin, 2010: 1154-1191; Gopalakrishnan/Damanpour, 1997: 15-28). This is framed by Robertson (1967: 14), stating that innovation occurs via a process in which a new idea, behavior or thing is conceived and brought into reality.

When seen as a process, Rogers (1962: 163-186) affirms that the development of the innovation process consists of all the decisions, activities and impacts that occur from the recognition of a need or problem through R&D, and commercialization of an innovation, through the diffusion and its adoption by users up to its consequences. The innovation process can have as a source the ideation where the organization acts as a generator (internal), or the incorporation of the innovation developed (external); there, the organization acts as an adopter of innovation (Crossan/Apaydin, 2010: 1154-1191; Gopalakrishnan/Damanpour, 1997: 15-28). Innovation generation is determined by the problem-solving and decision-making process required for the creation of new processes or products.

According to Gopalakrishnan/Damanpour (1997: 15-28), the process of creating something new involves five stages: idea generation, project definition, problem solving, design and development, and marketing or commercialization. The first three involve information about what's needed and how to meet that need, leading to a unique solution. The last two are making use of the resulting product or process. The adoption of innovation is a process that directly affects the technical and social systems of the organization and is composed of two main phases: the initiation that includes the understanding and openness of disposition towards innovation and the evaluation by taking a reference. The implementation of innovation involves two phases. The first is the trial implementation, which involves a limited application of the innovation to determine whether it meets the needs of the organization. The second phase is sustained implementation, in which the innovation has been assimilated into the organization. The OECD (2005) frames the adoption process within the diffusion of innovation, highlighting its importance due to the acquisition of knowledge and relating it to developments in products, processes, or other forms of innovation.

2.2.6 Typology and Dimensions of Innovations

A literature review of innovation typologies is important for the understanding of the digital platform economy as digital platforms are at the forefront of innovation in many industries and sectors, having changed traditional business models and created new

opportunities for value creation. A thorough examination of innovation typologies can provide insights into the various kinds of innovation happening in the digital platform economy and the factors that fuel platform innovation. This can also help to identify the critical factors that drive and facilitate it. By categorizing innovation types based on their key characteristics, specific types of innovation that are most relevant to digital platforms can be identified, along with factors that contribute to success, which informs business strategy and innovation efforts in the digital platform economy. Innovation has been classified in types, dimensions, and typologies to identify the innovative characteristics and degree of innovation, according to Garcia/Calantone (2002: 110-132).

Within literature, there are widely used terms such as radical, incremental, inherently new, discontinuous, and imitative innovation, as well as administrative, architectural, technical, modular, improved, evolutionary, revolutionary, generational, disruptive, and sustained innovation, among others (cf. Linton, 2009: 729-737). Robertson (1967: 14-19) classifies innovations by the effects on established technological patterns (cf. Sinkovics, 2018: 468-485): continuous innovations refer to changes in product features that do not create a significant impact on existing consumption patterns. Dynamically continuous innovations, on the other hand, involve the introduction of new products or modification of existing ones, which have a slightly more disruptive effect than continuous innovations but still do not alter consumption patterns. In contrast, discontinuous innovations refer to the introduction of new products that lead to significant changes in consumer behavior.

Abernathy/Clark (1985: 3-22) focus on the competitive importance of an innovation, using a two-dimensional diagram that analyzes technology against the background of the market. The resulting categories that have been crystalized are architectural, niche creation, regular, and revolutionary. Hereby, architectural innovation establishes new technologies that deviate from established ones, determining new links for markets and users, and fostering the entry of new industries or reform of existing ones. In creating niches, existing technologies are refined or improved to support marketing activities in new market niches. These are carried out through established technical skills, and their impact on the production system is incremental. Regular innovations are minimal improvements in technology and are built on established technical and production competencies, applied to existing markets and users. However, these can have a significant cumulative effect on production costs and technology performance. Radical innovations, according to the authors, render technical and production skills obsolete, but are aimed at existing markets and users.

Kleinschmidt/Cooper (1991: 240-251) define three categories on the scale of an innovation: high, moderate, and low. The highly innovative ones are based on new products for the world and new product lines, therefore new for the market. Moderately innovative ones consist of new or modified product lines for the organization, without the products being new to the market. Low innovations are modifications of existing products or redesign of products to reduce costs or repositioning. For Anderson/Tush-

man (1986: 439-465) technological change is a cumulative process until it is interrupted by a great advance and refers fundamentally to the emergence of different technologies from the dominant ones that, to be operated, require a change in base knowledge and skills within organizations. These new technologies cause discontinuities in the product, replacing existing and creating new classes, or incorporating improvements; or in the process that represent a new way of making a product.

These great technological changes and new technologies are classified as destroyers and enhancers of competency, as they destroy or improve the skills of a company or industry. Competency-enhancing innovation refers to innovations that strengthen the competencies, skills, and knowledge within an organization. In contrast, competency-destroying innovation makes existing competencies, skills, and knowledge irrelevant or obsolete (Gatignon et al., 2002: 1107). Dewar/Dutton (1986: 1422-1433) classify innovations as radical that are revolutionary changes in technology, moving away from existing and incremental practices that are improvements or adjustments in existing technology. Utterback (1996) states that discontinuous change or radical innovation describes a change that wipes out a large part of a company's existing investment in technical skills and knowledge, designs, production techniques, plant, and equipment (1996: 200); while continuous innovation allow for standardization and determine the status quo of the firm or industry (Garcia/Calantone (2002: 110-132).

Henderson/Clark (1990: 12) take the product as the unit of analysis and make a distinction between the product as a whole (system) and the product in its parts (components). A Component is a physically distinct part of the product that incorporates a basic design concept (Henderson/Clark, 1990: 11). Architectural innovation reconfigures an established system by linking existing components in new ways, i.e., it implies changes in the mechanisms that link the subsystems. The authors develop a two-dimensional matrix: the impact of innovation on components versus the impact on the links between the components, resulting in the typification of innovation as architectural, modular, radical, and incremental. Architectural innovation changes the architecture but maintains basic design concepts and components. Modular innovation changes only the basic design concepts or the relationship between them. Radical innovation establishes a dominant new design, and consequently a new set of basic design concepts embodied in components that are linked in a new architecture. Incremental innovation refines and extends an established design, improvements occur in individual components without altering the basic design concepts or their linkages.

For Garcia/Calantone (2002: 121) innovation is classified as radical, really new, and incremental. Radical innovation is one that causes both technological and market discontinuities at the macro (global, industry, or market) and micro (company and customer) levels and does not occur frequently. Radical innovations often fail to address a recognized demand, but instead create a demand that was previously unrecognized by the consumer. This new demand cultivates new industries with new competitors, firms, distribution channels and new marketing activities. Really new innovation incorporates really new products, i.e., they can evolve into new product lines, product line

extensions with new technology or new markets with existing technology causing a market or technology discontinuity at the macro level along with a discontinuity either in marketing, technology, or both. Incremental innovation refers to the development of new products or processes that build on existing technology or knowledge, adding new features, benefits, or improvements to the market. It does not fundamentally change the industry or cause significant disruptions in technology or the market. Instead, it occurs at a micro level, improving on existing technology and enhancing the overall value proposition for customers.

Bower/Christensen (1995) differentiate between two types of innovation, sustained and disruptive, based on their impact on technological developments. Sustained innovation aims to maintain a consistent rate of improvement by providing a product or service that offers better performance or enhanced attributes to an existing market. In contrast, disruptive innovation brings in entirely new sets of attributes, creates new classes of products or services, and leads to the creation of new markets altogether (Christensen/Overdorf, 2000: 1-10). Complementarily, Čiutienė/Thattakath (2014: 15-21) offer an integrative vision and relate incremental, breakthrough, radical, or game changer innovation and disruptive innovation in which they highlight that incremental innovation involves small changes - i.e., new characteristics or improvements - to existing products and catalogs it within sustained innovations which do not create new markets.

On the other hand, breakthrough innovation involves major technological changes resulting from R&D providing patents for formula, devices, and technology. This type of innovation, when generated in research laboratories, is not focused on a specific market, which makes it difficult to commercialize in established markets. Radical innovation creates technological advancements in the performance dimension and impacts the market by changing consumer behavior. It's important to note that there's a fine distinction between radical and disruptive innovation, and the terms are often used interchangeably. Disruptive innovation, however, refers to a completely new market created by introducing new classes of products or services with different attributes (Christensen et al., 2015: 44-53). Lastly, disruptive innovation doesn’t necessarily provide technological changes, but it does have great changes in the market.

This abundance of terminology has led to ambiguities and incongruous categorizations of the typology of innovation, causing confusion in the results of empirical research. What one researcher may call really new is classified radical or discontinuous by another (Garcia/Calantone, 2002: 110-132; Gatignon et al., 2002: 1103-1122). Distinguishing between different types of innovation requires identifying the focus of the innovation and the level at which it is being analyzed. These dimensions provide the basis for measuring and categorizing innovations and allow for comparisons and relationships to be drawn between different typologies. The locus of innovation is the source or point at which the innovation originates. This process can be a closed process driven internally (innovation generation) or an open process driven externally, i.e.,

by networks or alliances (Crossan/Apaydin, 2010: 1154-1191; Gopalakrishnan/Damanpour, 1997: 15-28). Utterback/Abernathy (1975: 646) highlight the importance of identifying the sources of the process to be promoted and developed and state that the place of innovation changes with the stage of development. In the initial phase of process development, known as unconnected stage, innovative knowledge is likely to come from individuals or organizations who have direct experience with the process rather than those who are familiar with cutting-edge technologies.

As such, the critical input is not said cutting-edge technology, but new insights into specific needs. Later, needs are well defined as they are being crystalized based on the existing system and as such resemble it as well and are more easily articulated consequentially. These needs lead to complex technological solutions, and the innovator will often be one who brings new technological perspectives to the problem. This can be a formal engineering or R&D group, an equipment company, or some other external source. One of the great sources of confusion about the language of innovation seems to be the perspective from which it is analyzed - i.e., the innovation analysis unit. This dispute has resulted in disagreement; what makes it essential to clarify what is being considered, by whom and for what purpose (Garcia/Calantone, 2002: 110-132; Gatignon et al., 2002: 1103-1122; Linton, 2009: 729-737; Markides, 2006: 19-25).

According to Linton (2009: 729-737), innovations are frequently analyzed from a technology perspective - which includes technology itself, products and/or processes - or the unit that exploits technology that can focus on the individual, organization, industry, or supply chain. Therefore, it is imperative to be clear about the perspective that the innovation is being considered from and identify the analysis unit. The unit of analysis focused on the individual as a consumer corresponds to marketing researchers, who seek to determine causes and characteristics of innovative consumer behavior that lead to improving marketing strategies (Subramanian/Nilakanta, 1996: 631-647). For researchers in organization theory and strategic management, the analysis unit is the organization. Research in this field analyzes contextual, structural, and behavioral characteristics that differentiate innovative from non-innovative organizations (Gopalakrishnan/Damanpour, 1997: 15-28; Subramanian/Nilakanta, 1996: 631-647).

Innovative companies are defined as prone to developing innovative products and/or adopting innovations (Garcia/Calantone, 2002: 110-132). Gopalakrishnan/Damanpour (1997: 18) state that research at the organizational level provides information on the role that innovation plays in management of the entire organization, such as adaptability to the environment, the ability to allocate resources to innovations versus resources to operation the general results of the organization and its effectiveness. Industry as a unit of analysis has an extra-industry or intra-industry focus. The extra-industry approach emphasizes technology opportunity as well as cross-industry magnitudes, encompassing industry expenditures on R&D and industry life-cycle stages, while the intra-industry approach addresses differences in times of adoption of an innovation between organizations of an industry and the implications of an innovation in the performance of an organization.

2.2.7 Organization and Impact of Innovation in the Area of Digital Platforms

The impact of an innovation is related to the degree of novelty and the magnitude of the change. The degree of novelty is presented under different perspectives depending on what and who measures the innovation. Innovation can be considered novel based on various perspectives, such as the world, the adoption unit, the industry, the market, or the consumer. However, research primarily focuses on the company's viewpoint, where the degree of discontinuity in market and/or technological factors is considered to assess the level of novelty (Garcia/Calantone, 2002: 112-113). These dimensions are related to the magnitude of the change (radical/incremental) and its effect at the micro level on an organization's competencies, status quo of technology, and market dynamics.

Consequently, Garcia/Calantone (2002: 110-132) make a distinction in the magnitude of the effect of an innovation from a macro and micro perspective. Innovation can be measured on both macro and micro levels. Macro level innovation refers to an innovation's ability to create a shift in technology or market structure within an industry, while micro level innovation refers to an innovation's ability to influence existing marketing resources, technological resources, skills, knowledge, capabilities, or strategy (Garcia/Calantone, 2002: 110-132). Based on this, innovation can be classified into three measures: its impact on existing skills within an organization; its impact on the current state of technology; and its impact on the existing market structure. The categories that stand out within literature to determine the magnitude of the impact of an innovation are the organizational dimension, i.e., enhancement of competencies versus the destruction of competencies (cf. Anderson/Tushman, 1986: 439-465), technological dimension, i.e., continuous versus discontinuous (cf. Robertson, 1967: 14-19), and market dimension, i.e., disruptive versus sustained (cf. Bower/Christensen, 1995).

In relation to the organizational dimension (cf. Holt et al. 1995: 136; Starbuck, 2003: 143-182), large technological changes can cause destruction of skills or improvement of these within companies in each industry. Changes in process technology or in product technology may establish needs that the existing resources, skills, and knowledge partially satisfy (or not), reduce the value of existing competencies and, in extreme cases, render them even obsolete. This effect can destroy companies and even industries and create new ones in turn. This kind of change is the foundation of Schumpeter's theory of innovation and economic development, where creative destruction (cf. Sombart, 1913: 4, 207; Reinert/Reinert, 2006: 55-85; Pfarrer/Smith, 2015: 1-3) is the vehicle of economic growth (Abernathy/Clark, 1985: 6). All innovations involve changes of some kind or impact within the organization. This impact influences the resources, skills, and knowledge existing in a company, i.e., while innovations help to improve the organization's existing competencies. Radical innovations can have a negative impact on the resources, skills, and knowledge that a company possesses. Rather than improving and strengthening these factors, radical innovations can destroy them by requiring completely different resources, skills, and knowledge that the organ-

ization may not have. Hereby, according to Dosi (1982:147-162), technology is a cumulative process that can be interrupted by major advance or discontinuity and that is defined as the set of practical and theoretical knowledge, know-how, methods, procedures, successful and unsuccessful experiences, devices, and equipment.

Anderson/Tushman (1986: 440) define technology as the tools, equipment, and knowledge that mediate between inputs and outputs (process technology) or create new products or services (product technology). Impact of technological change depends on the direction of advancement or pattern of progress (Dosi, 1982: 148). Technological progress can be described as an evolutionary system that is periodically interrupted by discontinuous changes. According to Dosi (1982: 147-162) and Gatignon et al. (2002: 1103-1122), these changes can be categorized as incremental innovations, which involve refining and improving existing technological developments to enhance the price/performance ratio, and radical innovations, which disrupt existing technological developments.

Abernathy/Clark (1985: 3-22) suggest that the impact of a new technology is closely tied to the creation of new connections with markets and users. The introduction of new technologies can lead to the creation of new industries or changes to existing ones, providing new opportunities for markets and customers. Garcia and Calantone (2002: 118) propose that innovation impact can be evaluated by considering external factors such as the industry's familiarity with the innovation and the emergence of new competitors following the innovation's launch. Improvements in existing technologies or small technological changes leading to performance refinements promote and stimulate new market niches and opportunities, as stated by Abernathy/Clark (1985: 3-22). Bower/Christensen (1995) examine the impact on markets and established companies by categorizing innovations into disruptive and sustained innovations.

Based on the literature reviewed, the relationship between disruptive, radical, incremental, and sustained innovation can be established - considering the literature and contrasting the definitions, the terms of discontinuous and continuous are classified within radical and incremental innovation respectively. Incremental innovation pertains to minor adjustments made to a product or service to improve its attributes and meet the needs and expectations of existing customers. Radical innovations imply big changes and a break within the technological trajectory creating entirely different products to satisfy current customers, and that can create new markets. On the other hand, that sustained innovation includes radical and incremental innovations from the perspective of a technological development and tends to satisfy the needs of current customers, while disruptive innovation does not necessarily involve major technological changes, however, it has a great impact, also creating new markets.

The emergence of the World Wide Web stands as a significant milestone in the history of technology. This innovative development facilitated the establishment of an extensive web of linked documents and resources, laying the groundwork for the birth of digital platforms. Cloud computing has played a crucial role in the growth of the

digital platform economy by enabling users to access computing resources and data storage via the internet, while mobile technology has been an even more important factor, as smartphones and tablets have become widespread in many parts of the world. These devices have made it possible for people to access digital platforms from anywhere and at any time, which has led to the development of mobile apps and mobile-specific versions of digital platforms. The rise of social media platforms has been a significant innovation in the digital platform economy, as these have provided a means for people to connect and share information, and they have created new opportunities for businesses to engage with customers. AI/ML have also been impactful technological innovations to automate tasks, personalize recommendations and services, and improve overall user experiences. Additionally, blockchain technology has emerged as a promising innovation for the digital platform economy, with its potential to create secure, decentralized platforms.

Digital platforms have had strong impact on various aspects of our lives, including the economy, society, and personal lives. They have profoundly disrupted the conventional business models, introduced innovative ways of creating value, and altered the way people interact, consume and work (Keese, 2016: 107-119). The rise of platforms has paved the way for new business models, such as the sharing (cf. Agarwal/Steinmetz, 2019; Hamari et al., 2016: 2047-2059; Schor et al., 2015: 12-19) and gig economy (Bulian, 2021: 106-119; Janadari/Preena, 2020: 1-14; Ostoj, 2021: 451-462), which have redefined traditional notions of ownership and work. One key impact of platform innovation is the democratization of innovation and entrepreneurship. Platforms have lowered the barriers to entry for new businesses and enabled individuals to become entrepreneurs and innovators. Platforms such as e.g., Kickstarter (Wang et al., 2021: 1-14) and Patreon (Regner, 2020) have enabled creators and artists to monetize their work directly from fans, while platforms such as Etsy (Church/Oakley, 2018: 1-21) and Shopify (cf. Dushnitsky/Stroube, 2021) have enabled SMBs to reach global markets and compete with larger incumbents. Platforms have also transformed the way that people work and consume. Digital platforms like e.g., Uber (cf. Dudley et al., 2017; Kooti et al., 2017: 574-582) and Airbnb (Hijrah Hati et al. 2021; Núñez-Tabales et al. 2020; Oskam/Boswijk, 2015: 22-42) have also made it possible for individuals to earn money by renting out their assets (e.g., cars, homes), through the sharing economy. Similarly, according to Galloway, platforms like Amazon (2017: 13-62) and Alibaba (2017: 206-210) have revolutionized the way people shop by offering easy access to a vast array of services from anywhere in the world.

2.3 Role, Terminology, Definitions of Disruption, its Characteristics, Impact and Responses

2.3.1 Disruption and its Role in the Digital Platform Economy

The digital platform economy has been characterized by disruptive innovations that have transformed traditional business models and markets. The concept of disruption,

coined by Christensen in the late 1990s (1997; Bower/Christensen, 1995), describes the process by which new technologies and business models disrupt and displace established products and services. This process is particularly relevant in the digital platform economy, where new platforms and technologies have disrupted industries such as transportation, lodging, and retail. The emergence of novel business models (e.g., the sharing platforms) has been a result of disruption caused by digital platforms. These platforms allow for efficient use of underutilized assets and peer-to-peer transactions. However, the disruption has also brought up important issues about employment relationships, regulation, and employment (Keese, 2016: 107-119).

In the upcoming chapters, this study reviews academic theories that have been developed to comprehend the effect of disruption on the digital platform economy. Understanding these theories is important for policy, businesses, and individuals who are affected by the disruption caused by the digital platform economy: policymakers must balance the benefits of innovation with the potential negative consequences, such as job displacement and the concentration of market power in the hands of a few dominant platforms, while businesses must adapt to new technologies and business models to remain competitive, and while individuals must navigate the changing landscape of work and employment relationships. In this chapter, the study will first discuss various perspectives on the concept of disruptive innovation and explore how it is perceived as a process. Consequently, different perspectives are contrasted to identify common characteristics and introduce internal and external factors that prevent companies from facing disruptive innovations, introducing dynamic capabilities.

The digital platform economy has experienced disruption since the early days of the internet, when e-commerce and online marketplaces like Amazon (Galloway, 2017: 13-62) and eBay began to emerge. These platforms disrupted traditional brick-and-mortar retail by offering a more convenient and efficient way to shop. The advent of social media platforms, including Facebook, Twitter, and LinkedIn, in the mid-2000s brought about another stage of disruption as these platforms transformed how people communicate, share information, and form relationships. These platforms leveraged user-generated content to drive engagement and build massive user bases, making them attractive targets for advertisers and marketers. In the early 2010s, the sharing economy emerged as a major disruptor in industries such as transportation (Uber, Lyft, cf. Dudley et al., 2017; Kooti et al., 2017: 574-582), lodging (Airbnb), and food delivery (e.g., through Grubhub, or Postmates). These platforms enabled individuals to share their assets (e.g., cars, homes) and services (e.g., driving, cooking) with others, creating new business models that challenged traditional incumbents.

Today, disruptive innovation can be observed in numerous industries. Popular examples are Airbnb (Hijrah Hati et al. 2021; Núñez-Tabales et al. 2020; Oskam/Boswijk, 2015: 22-42) in the area of tourism, allowing customers to rent rooms in residential properties rather than in hotels; Uber, a transportation network where drivers use their own personal cars to serve clients (cf. Kooti et al., 2017: 574-582; Dudley et al., 2017; Galloway, 2017: 214-220), or the Apple Music Store, which allows customers to avoid

the former constraint to buy an entire album of an artist and offers the opportunity to acquire just selected titles on a digital sell-through basis and with no physical ownership involved (Walter/Hess, 2003: 541-546). Google, next to its breakthrough-innovation of a search engine based on quantity and quality of aggregated links and the resulting success in generating advertising revenue (Galloway, 2017: 126-156), created a similar disrupting innovation with the mobile operating system Android which today dominates the smartphone OS market with more than 71% (Statista, 2023a) and which now operates on over 3b devices (Cranz, 2021). More recently, the rise of on-demand platforms such as TaskRabbit or Upwork has disrupted traditional employment models, offering individuals the ability to work as freelancers or independent contractors.

All these services have in common that they turned into platforms over time, forcing market participants to adhere to technical and editorial regulations of the respective player due to their size and dominance, as they own the direct customer relationship. While both platforms and vendors can profit from this system (vendors, since they don't hold any responsibility in terms of technical setup and sales channels and can instead focus on their offering, whether it being an application or content), it is ultimately the platform that controls the relationship as it regulates competitive pressure among marketplace participants, and the platform has the ability to enhance innovation along with the opportunity to create ecosystems (cf. Gawer/Cusumano, 2008), observable in players such as Apple, Amazon, Alphabet and Meta (cf. Galloway, 2017).

As such, the digital platform economy has been subject to various technological disruptions over the years that have fundamentally transformed the landscape of the industry. One such technological disruption was the introduction of cloud computing, which enabled platforms to offer scalable infrastructure, storage, and computing power to users in a cost-effective manner, leading to the creation of cloud-based platforms (e.g., AWS, Google Cloud Platform, and Microsoft Azure) which disrupted the traditional IT infrastructure market. Another significant disruption was the widespread adoption of mobile devices, which enabled users to access digital platforms from anywhere and at any time, leading to the emergence of mobile-first platforms such as Uber (cf. Dudley et al., 2017), Airbnb, and Instagram, which disrupted traditional business models and industries such as transportation, hospitality, and advertising. The rise of AI/ML technologies has also been a disruptive force in the digital platform economy. Platforms such as Amazon, Netflix, and Spotify use these technologies to personalize user experiences and recommend products and services, which has led to higher engagement and customer loyalty. Blockchain technology has also been a disruptive force in the digital platform economy, enabling the creation of decentralized platforms that eliminate intermediaries and reduce transaction costs. Platforms such as Bitcoin and Ethereum (cf. Vujičić et al., 2018: 1-6) have disrupted traditional financial systems and enabled new forms of peer-to-peer transactions. The digital platform economy has been further disrupted with the emergence of the IoT, which made it possible to collect and analyze large volumes of data sets sourced from interconnected devices, leading

to the emergence of new platforms such as Fitbit, Nest, and SmartThings, which enable users to monitor and control aspects of their lives.

2.3.2 Definitions of Disruption in Literature

Disruption refers to a process where technological innovation and developments transform businesses and change audience consumption and reception, leading to significant shifts or evolution in industries such as print, advertising, photography, radio, or video, as noted by Lister et al. (2008). This ongoing transformational event is driven by competition among market players, as they strive to attract and retain more customers to generate revenue. Bower and Christensen (1995) first introduced the term disruptive innovation, and subsequent authors have provided different conceptual approaches to describe the process, impact, and responses to disruptive innovation. As technology evolves and follows an evolutionary lifecycle, businesses must adapt to fundamental rearrangements brought about by ongoing digitalization. In recent decades, there has been a noticeable surge in the rate of technological advancements and product launches, particularly and predominantly in the field of electronic media. Today, electronic media can be found in various forms, including TV's, laptops, smartphones, and game consoles. The fast-paced technological advancements observed today not only trigger shorter innovation periods and product cycles but also demand a broader meaning of digitalization as it affects human interaction. The constant evolution of technology emphasizes the significance of comprehending the effects of disruption on various industries. The term disruption, overall, is widely employed in current media, as stated by Narula (2006).

The term disruptive has been applied in literature mainly to describe sudden change. It roots in the Latin word disrumpere, meaning immediate rupture, or sudden interruption. The term disruptive technologies was initially addressed by Christensen (Bower/Christensen, 1995) to explain the impact that different classes of technological innovations have. In the researched field, disruption as a term is being used for the description of the consequences and impact of an innovation from the perspective of technology in relation to change. In 1997 the term is used for the first, describing a strategy to expand into and develop additional markets. However, its definition was extended in Christensen's seminal work The Innovator's Dilemma (1997), making a significant contribution to literature, that impacted and continues to impact both the business world and the academic community (Tellis, 2005: 34-38) and that had further impact on executives and general management, as it represented a key element for the expansion and development of new markets (Yu/Hang, 2008).

Christensen refined the term further (1997) as an innovation that creates a new market by providing a different set of values, which ultimately (and unexpectedly) overtakes an existing market. His work has been extensively discussed and referenced in various fields and academic disciplines, including marketing, management, technology management, strategy, and NPD (cf. Danneels, 2004: 246-258; Ramdorai/Herstatt,

2015). Christensen offers an economic rationale for radical thinking: the dilemma he refers to doesn't relate to innovative start-ups, but to large and successful corporates instead, which came to their success by an innovation created in the past, and describes the economic decline of large corporates as a necessary process of development, thereby adopting end elaborating on prior theories such as the idea of creative destruction (Schumpeter, 2003; Reinert/Reinert, 2006: 55-85; Pfarrer/Smith, 2015: 1-3). Christensen (1997) elaborates that the dilemma of large corporates is to be victims of their own success - by changing their core business they run the risk of losing their most loyal customers, which in most instances account for the most relevant revenue stream within the company, and which in turn is what steak-holders mostly demand to be consistent or growing. Thus, in most cases it doesn't appear as sound business judgement to put the own business model at risk by pushing towards an uncertain venture, which, as a start-up, contains a strong likelihood to fail, whereas it is the start-ups instead which can base their business model on disruptive innovation since these have nothing or little to lose and much to win.

Disruptive innovation, defined as innovation that impacts a market, possesses unique qualities which enable organizations to tackle challenges in a transformative manner, as they are the ones that foster an organization's ability to achieve novel and innovative forms of competitive advantage. Based on this assumption, and in the event that innovation exceed their original aims, disruptive innovation becomes a mechanism to improve innovative activity in competitive environments in a rather exceptional manner, as it is characterized by 1) having lower attributes than those valued by the main market; 2) offering a lower price in comparison to the market; 3) penetrating the market from niches to the main market; and 4) typical products or services that are based on existing technologies and that are accessible and simple. These four characteristics are a summary of elaborations from various authors (Christensen, 1997, 1995; Govindarajan/Kopalle, 2006: 189-199; Hang et al., 2015: 21-26, Tellis, 2005: 34-38; Yu/Hang, 2008: 435-452).

Hart/Christensen (2002: 51-56) point out that e.g., developing countries are ideal markets for disruptive technologies, firstly because business models forged in low-income markets can be profitably applied in more places than models in high-income markets, and second, by competing against non-consumption, which implies providing a service / product to individuals who lack access to existing offerings and are content with more basic options compared to those in advanced markets. In addition, recognizing technological and market opportunities that have disruptive potential necessitates a transformation of the organization, including competencies and resource configuration. To accomplish this, dynamic capabilities provide a framework for instigating disruptive innovation within organizations.

Christensen (2006: 42) later commented that the term disruptive could be interpreted in various ways in the English language, as it could be associated with concepts such as failure and radical change, in addition to the already described phenomenon

to which Christensen applied it. Christensen et al. (2015: 44-53) stated that it is worrying to see the term being utilized often and out of context throughout research, resulting in the description of numerous situations in which an industry is impacted by an innovation or where companies are challenged, thus being applied in a too broad area. Today, the term is being used as a synonym with changes in terms of market dynamics and the way in which new players can enter a market and challenge incumbents by developing and rolling out new technologies with changes in their attributes that are valued by customers. As such, disruptive innovation can drive growth in areas where it impacts or even creates new industries through introducing services, products, or business models which, due to their simple and often basic appearance allow for a completely new convenience, customer experience and usage.

Christensen (1997) aimed to provide an explanation as to why leading firms in a market fail when faced with technological changes. It is a common occurrence in the business world that leading companies fail to maintain their positions in the industry when there are changes in technologies or markets, as observed by Bower/Christensen (1995). This has been approached by Anderson/Tushman (1986: 439-465) from an organizational perspective, in which technological changes can consolidate (competency-enhancing) or displace (competency-destroying) established companies. The authors argue that discontinuous, competency-destroying technologies are initiated by new companies and lead to failure because as they render existing skills, competencies, and knowledge in existing companies obsolete. Henderson/Clark (1990: 9) reaffirm this by introducing the terms of architectural and component innovation, arguing that architectural innovations challenge established companies as they change the architecture of the product, destroy the utility of architectural knowledge and that, since architectural knowledge tends to be integrated into the structure and information processing procedures of established organizations, this destruction is difficult to recognize and correct.

Christensen (1997) proposes an alternative explanation to these failures when examining the Hard Disk Drive (HDD) industry, where disruptive technologies have caused industry disruptions by shifting from larger to smaller drives, like from 14’ to 8’, 8’ to 5.25’, and 5.25’ to 3.5’. The main market initially did not value these drives due to their lower storage capacity. However, they were valued by niche markets like minicomputers, desktops, and notebooks due to their smaller size and weight. For example, while 5.25’ drives were valued for desktop manufacturing, 3.5’ drives were preferred by notebook manufacturers due to their smaller size, despite lower storage capacity. Eventually, 3.5’ drives improved enough to be accepted by desktop manufacturers, replacing 5.25’ drives. This pattern has been observed in many other industries as well. For example, Kodak, a former dominant player in the photography industry, failed to adapt to the rise of digital photography and ultimately filed for bankruptcy in 2012 (Vitton et al., 2014: 63-66). Blockbuster, which was the leading video rental pro-

vider in the 1990s, failed to adapt to the rise of streaming services like Netflix (Weinman, 2015: 197-210; Green, 2023) and ultimately went out of business shortly after (Lechmanová et al., 2020).

Following this terminology, disruptive innovation differentiates between so-called sustained innovations (Hoque, 2007; King/Baatartogtokh, 2014: 77-90) that can be inherently discontinuous, radical, or incremental in nature and focus on improving characteristics of established products to satisfy core market customers. Most of the technological advances in industries fall into this category. Disruptive innovations introduce a very different set of attributes and are initially considered inferior in one or two dimensions that major customers have historically valued; however, they have other characteristics that some marginal customers, and generally new ones, value, which leads to lower prices in the market (cf. Bower/Christensen, 1995; Christensen, 1997; Christensen et al., 2015: 44-53). Danneels (2004: 249) suggests that disruptive technology refers to a type of technology that fundamentally alters the competition landscape by changing the performance criteria that firms use to compete, while Govindarajan/Kopalle (2006: 194) approach the concept as bundle of characteristics when elaborating that disruptive innovation introduces a set of characteristics, performance, and pricing attributes different from existing products, an unattractive combination for main customers at the time of the introduction of the product due to its inferior performance on the attributes that main clients value, and/or to the higher price point - however, a different segment of customers may value these new attributes. Subsequent developments, however, improve the attributes of the new product to a level that is good enough to satisfy core market customers, thus attracting more customers.

2.3.3 Disruptive Innovation Understood as a Process

For Christensen et al. (2015: 44-53) the term disruptive innovation has been misunderstood when being characterized as a product or service. Disruptive innovation rather is a process that occurs over a period, and not a singular event (cf. Christensen, 2006: 39-55; Christensen et al., 2015: 44-53). In some instances, this disruption process can take years, even decades (Christensen/Raynor, 2003). Therefore, it is difficult to determine at what point in time an innovation becomes disruptive. Christensen (1997) focuses on technological innovations to explore how new technologies displace existing ones and create new markets. Christensen/Raynor (2003) expand the term disruptive technology by the term disruptive innovation to broaden the field of application of the concept, and that there are both technological innovations and innovations in services and business models, e.g., low-cost airlines, online education businesses, department stores (Danneels, 2004: 246-258; Markides, 2006: 19-25). According to Christensen et al. (2015: 44-53), technologies that are disruptive have a set of attributes that are very different from those historically valued by traditional customers. These technologies offer a basic level of performance according to the metrics that these customers value, making them unattractive within already established markets.

However, these other attributes, such as simplicity, convenience, and low cost, are valued in new markets. During this process, disruptive technologies evoke sustained innovations, which improve in the dimension valued by customers in the main market until they intercept the performance trajectory required by these clients, as pointed out by various authors in the field, such as Bower/Christensen (1995); Christensen (1997; 2002); Christensen/Overdorf (2000: 1-10); Danneels (2004: 246-258); Ramdorai/Herstatt (2015); Yu/Hang (2008). As demonstrated, Christensen (1997) builds this concept based on an investigation carried out in the hard disk industry, following the technological changes in this industry for 25 years, during which he evidenced the disruption process three times. This process is more clearly explained by Christensen's (1997: xvi) in what is called the product performance trajectory (i.e., the impact of sustaining and disruptive technological change), and how products improve further over time is contrasted with the customer demand trajectories and their progress due to sustaining and disruptive technologies, respectively.

Initially, disruptive innovations are not satisfying the performance that the core market demands - consumers belonging to the main market increasingly considering them as unnecessary. However, as time and the iteration process evolve, disruptive innovation improves in terms of performance attributes so that it meets or exceeds the demand of the core (established) market, satisfying the low-level market and the main market alike. Simultaneously, the established trajectory keeps sustained innovations to meet the needs of high-end clients as these are more profitable and exceed the capacity to absorb low-end and main clients, decreasing their marginal utility, which is shown in their willingness to pay for the dominant innovation (Adner, 2002: 667-688; Danneels, 2004: 246-258). Disruptive innovation draws customers towards its performance, which possesses attributes distinct from those previously valued by conventional customers, providing a fundamental performance that is not attractive in established markets (Christensen, 1997; Christensen et al., 2015: 44-53; Danneels, 2004: 246-258; Yu/Hang, 2008).

The disruptive innovation process foresees that products are valued in markets that were initially left aside or got ignored by established firms (cf. Adner, 2002: 667-688; Christensen, 1997; Christensen/Raynor, 2003, Govindarajan/Kopalle, 2006: 189-199). Christensen/Raynor (2003: 102) define these markets as marginal markets and split them into low-market levels that refer to gaps resulting from the fact that incumbents steer their attention to highly demanding and more profitable customers by pushing their products and services to over-performance in their traditional dimensions, limiting their interest in less demanding clients. This process drives disruptors to focus on providing products that function just well enough for these low-market customers. For new markets, the disrupting company creates an entirely new area that turns people who didn't consume into future consumers.

Christensen's model assumes that the performance levels demanded by customers in an existing market segment are distributed, i.e., the extremes represent the low-end and high-end clients, while the high-end customers of the main market represent

the average performance level that is in demand. Rogers (1962: 201) classified adopters into different categories, including innovators, early adopters, late majority, early majority, as well as, finally, laggards, using the normal distribution. Low-end customers, who have less capacity to absorb sustained performance improvements, are more inclined to adopt disruptive innovations. In contrast, high-end customers are less susceptible because they have a higher capacity to absorb sustained performance improvements (Schmidt/Druehl, 2008: 347-369). When the performance of a disruptive innovation intersects with the performance demand of a different market segment, it has the potential to succeed.

2.3.4 Perspectives on and Characteristics of Disruption

There are contributions from different organizational and market perspectives to the development of the concept of disruptive innovation (cf. Danneels, 2004: 246-258; Danneels, 2006: 2-4; Govindarajan/Kopalle, 2006: 189-199). As mentioned, within his study on Hard Disk Drives, Christensen (1997) established that companies led technological changes regardless of whether they were radical, incremental, cheap, or expensive technologies of components or structure, competency-enhancer, or competency-destroyer, when these were sustained in nature, i.e., these could provide better on the attributes that the main customers valued (failing, however, when confronted, with the rise of a disruptive technology). Christensen (1997) argues that disruptive innovations were technologically simpler and consisted of already available components that were assembled differently, leading to a product architecture often simpler than previous approaches and compared to industry analytics of hard drives. In literature, common characteristics emerge in which disruptive innovation develops. Christensen (1997) sees disruptive technologies as simpler, cheaper, and more convenient, emerging in low-end segments of the market and as being ignored by established companies, improving performances to meet core market needs. Christensen/Raynor (2003) add that low-end disruptions target the lower level of a value network, new market disruptions, which foster a new value network (cf. Peppard/Rylander Eklund, 2006: 128-141).

King/Baatartogtokh (2014: 77-90) consider that more established companies hold an advantage in terms of sustained innovation, which over time exceeds the requirements of their main customer groups, leading to failure the latest once these enterprises are confronted with disruptive innovations. Thomond/Lettice (2002) see disruptive innovations commence their performance given unsatisfied needs in new or small markets. Their most performant KPI’s are regarded in favor by a niche target group while being largely ignored by large, more meaningful markets. These market customers as well as competitors value a variety of KPI’s and view the innovation as underperforming. As such, the adoption of niche market areas drives investments in the offer to push the performance further, as the creation of a new market segment or the expansion to another customer group might be considered. Knowledge about the offer (service, product, or business model) is built and drives the change in how customers

in the key market regard the innovation and its advantages. The switch in the key market's perception of the advantages of the innovation is the catalyst that enables the innovation to disrupt and displace existing services, products, business models (Thomond/Lettice, 2002: 4). Similarly, Govindarajan/Kopalle (2006: 189-199) see disruptive innovations underperforming on values that existing customers like, while new values that these have on offer aren't important enough for the main market. According to these authors, innovations are usually less complex and costly than the dominant products. When they enter the market, these innovations target low-end and price-sensitive customer groups, which can reduce the profitability of established companies. However, over time, the development and implementation of these new products or services improve, and they begin to serve the previously valued attributes of the key market more effectively. As a result, sales increase with this customer group.

Tellis (2005: 34-38) considers disruptive technologies as being of lower quality in the beginning and show lower performance in comparison with established products or services or business models. However, offers show preferences that other customer groups value (e.g., convenient, higher bargain, simple usage). The established companies are not responsive to these new technologies as these are firstly being adopted in smaller and less meaningful markets and not in the main key market. Disruptive technologies then improve over time until they are being considered and adopted by the main market, step by step replacing existing technologies as established companies become obsolete in the process. Adner (2002: 667-688) sees disruption occur when technological sets of settled companies are exchanged from their key market as innovations are introduced that might not perform in terms of the values which main customers appreciate. These purchase disruptive technologies even though they underperform on the main attributes, while established businesses are reluctant or unable to counter the innovation. Within these different characterizations, patterns emerge: disruptive innovation occurs in marginal markets (Christensen/Raynor, 2003), main customer groups value specific core attributes, there is oversupply in terms of performance against these and disruptive innovations usually have lower price-points, as they are simpler in nature.

In relation to marginal markets, Christensen/Raynor (2003) point out that disruptive innovations are generated in market spaces that established companies ignore and consider them as marginal, and that these are divided into low-end markets and new markets. The low-end market positions refer to the market gaps that emerge due to the established companies focusing on high-end customers, offering more advanced services / products, and neglecting the low-end customers. As a result, the low-end customers are left unserved and unattended. This creates an opportunity for new players to enter the market, focusing on providing services or products which meet the basic needs of these previously ignored customers. The new market position sees players create new markets in a way that turns non-consumers into consumers. Complementarily, Govindarajan/Kopalle (2006: 189-199) point out that, as the disruption construct is different from the radical dimension, disruptive innovations can be low-end

(i.e., technologically less radical) as well as high-end (i.e., technologically more radical) and offer reasons why disruptive high-end innovations create a dilemma for established companies: 1) core customers don't value new performance features at product introduction; 2) the innovation performs poorly on attributes that top customers value; 3) the innovation attracts an emerging or insignificant market niche; and 4) while the disruptive product offers a higher margin per unit, the smaller perceived market size renders the profit potential as limited.

Regarding core performance attributes, they are related to how much an innovation enhances a particular attribute or set of attributes that are highly appreciated by the main customer base (Christensen, 1997: 172). Adner (2002: 672) argues in this regard that, as technology development progresses, the performance requirements of consumers are met, and then exceeded, by their adopted technology. As performance continues to exceed consumer requirements, consumers' willingness to pay for upgrades diminishes, opening the door to lower-priced, underperforming - disruptive - offerings to capture these consumers. Core customers value performance characteristics that disruptive innovations are initially unable to supply. Established companies then focus on improving these performance metrics. This tendency to stay close to the main customers directs efforts in the continuous improvement of the performance of existing technologies aimed at satisfying the main market segments. Disruptive innovations have the potential to succeed when the rate of technological improvement in established innovations surpasses the market's ability to absorb them. This creates an opportunity for disruptive innovations that offer secondary attributes in already extensively or even super-served markets. In relation to performance oversupply, the according metrics allow customers to begin to value attributes that had previously been classified as secondary (cf. Adner, 2002: 667-688; Christensen, 1997: 173; Danneels, 2004: 246-258). Christensen (1997: 173) uses the term performance oversupply to explain why customers embrace disruptive innovation while more sophisticated options exist within the market. There are three main factors that lead companies to consider moving up-market: the superior markets offer better profit margins; customers may be resistant to change and unwilling to shift to new products or services; and the cost structures required to cater to lower markets may become too demanding.

Adner (2002) examines disruptive innovation through a lens of demand structure, which involves analyzing the relationship between two elements of market segments: preference overlap and preference symmetry. Preference overlap herein is understood as the degree to which performance improvements in one market segment are also valued by another market segment. It refers to the level of similarity between their functional preferences (Adner/Zemsky, 2005: 229-254). As the level of preference overlap increases, the value trajectories of the segments become closer, and the segments grow larger in proportion to the level of product performance (Adner, 2002: 672). Preference symmetry refers to the parity of this position, i.e., the relative value that each segment places on performance improvements along another value segment trajectory. Adner's (2002: 667-688) assumption is that the value of innovation comes from

the order of its attributes. The way innovations are perceived is indirectly related to the attributes they offer. With increased overlap of preferences, the distance between disruptive and dominant innovations becomes smaller because of the similarities in the preferences of the segments (Adner/Zemsky, 2005: 229-254).

Hence, disruptive innovations can enter existing markets with ease due to the enhancement of performance. Whenever the value trend of innovative technologies meets the demand boundaries of significant customer segments, novel technology can gain ground. Performance improvements in established technologies that exceed the limits of demand of the main market are subject to a decrease in marginal utility since the moment a product improves beyond the possibility of taking advantage of said improvements, and the implicit value given by the consumer decreases. Hence, the benefit that is obtained from the extra performance provided by disruptive innovations will ultimately drive market competition to a new level of performance, leading to disruption. But when preference overlap is low or absent, market segment preferences are diverse, which results in isolation from competition. Therefore, the functional preferences of unconnected market segments are entirely fulfilled by the performance improvements of the current innovations, decreasing the chance of disruption. However, as market segment preferences increase, the ability of an innovation to penetrate competing market segments increases as well (Adner, 2002: 687). Yu/Hang (2008) suggest that market disruption usually occurs when there is an overabundance of performance supply from the established innovations in primary attributes. However, Adner (2002) disagrees with this notion, arguing that other attributes also play a significant role. Christensen (1997) highlights hydraulic excavation technology as a determining factor in disruptive innovation, which offers cheaper prices due to new technological combinations and better cost structures. Adner (2002) suggests that consumer preferences may be affected by budget limitations or the ability to understand new functionalities.

2.3.5 Why Disruptive Innovations Succeed Over Incumbents

The digital platform economy has seen many examples of disruptive innovations that have disrupted established incumbents, e.g., Uber and Lyft (ride-sharing industry, cf. Kooti et al., 2017: 574-582; Dudley et al., 2017), Airbnb (hospitality industry; cf. Hijrah Hati et al. 2021; Núñez-Tabales et al. 2020; Oskam/Boswijk, 2015: 22-42), or Amazon (retail industry, cf. Galloway, 2017: 13-62). The success of these disruptive platforms can be attributed to their capability to offer more efficient and convenient services that cater to the changing demands of consumers. They leverage technology to create innovative business models that provide greater value to consumers at lower prices than established incumbents. Additionally, they create new value networks (cf. Peppard/Rylander Eklund, 2006: 128-141) that redefine the roles of various participants in the ecosystem, such as consumers, producers, and regulators. This enables them to circumvent the traditional regulatory and legal hurdles that established incumbents face. The phenomenon of disruptive innovation, whereby small and previously

insignificant firms develop and launch low-cost, simple, and initially less capable products that overtake incumbents, has been a topic of considerable interest in management and innovation research. Scholars have debated the causes and mechanisms of how incumbents can be beaten by upstart firms using disruptive innovations, and why some incumbents are able to survive and even thrive in the face of disruptive threats, while others falter and decline.

The failure of companies to maintain leadership in an industry or its disappearance is mainly due to three factors: organizational culture (Christensen, 1997), organizational skills (Henderson, 2005: 5-11), and cognitive failures of senior management (Tellis, 2005: 34-38). While Christensen (1997) focuses on value networks and managerial processes and dynamic organizations, Henderson (2005: 5-11) and Danneels (2004: 246-258) approach the problem from tackling organizational competence. Christensen (1997: 4, 73) argues that the failure of leading companies in an industry is mainly due to listening too well to their main customers. Christensen/Rosenbloom (1995: 233-257) argue that success or failure of established and new companies is attributed to three forces that converge: 1) the magnitude of technological innovation on the capabilities of the firm; 2) management processes and organizational dynamics; and 3) value networks. In relation to these value networks, one possible explanation for why successful companies fail points to organizational impediments as the main problem, in the form of bureaucracy, or in form of a culture of risk aversion (Christensen, 1997: 29-30).

Henderson/Clark (1990: 9-30) conclude that once a dominant product design is established and developed, companies improve performance within the master architecture, i.e., they develop the components while maintaining the links and interactions. This means that when a new architecture arises, the organizational structures that were based on the links of the previous technology become obsolete, producing a problem given the time and resources that it means to change to a different structure (Christensen, 1997: 30). Products and services offered by companies are not standalone entities, but rather are made up of interconnected components that work together within a larger system or architectural design. This interconnectedness means that the products and services are part of larger value networks that define the boundaries of what the company can and cannot do. In other words, the value network influences and shapes the capabilities and limitations of the company within a particular industry or market. The value network includes the suppliers, distributors, customers, and other actors that are involved in the creation, distribution, and consumption of the company's products and services (cf. Christensen, 1997; Christensen/Rosenbloom, 1995: 233-257; Henderson/Clark, 1990: 9-30).

Christensen/Rosenbloom (1995: 234) define the value network as the ecosystem in which a company operates, identifying and addressing customer needs, solving problems, responding to competition, and seeking to generate profit. Technological changes in a value network can profoundly affect a company's resource allocation and capacity. Each value network is bounded by the definition of product performance, which sets specific attributes along a particular path that distinguishes it from other

networks within the same industry. Companies that are already established typically produce both component and architectural technologies that meet the requirements of their main clients, while following the same path as the network. However, they are hesitant to invest in technologies that meet the requirements of emerging value networks and do not align with their existing customers' demands. Such decisions can lead to disaster when two different trajectories intersect. When companies gain experience in a value network, they develop organizational structures, cultures, and capacities that align with the requirements of that network. If two technological trajectories have similar curves, the technology should remain in the same value network. However, when the curves differ, technologies that are initially competitive in emerging value networks may migrate towards established ones. Each value network has a different classification in relation to the attributes, considering the importance of a product, which is called value metrics (Weinstein, 2018: 157-174). According to Christensen (1997: 36), parallel value networks can exist, defining the value of technology differently (cf. Golnam et al., 2014: 47-68).

When faced with disruption, established companies often fail due to managerial decision-making that focuses on developing technologies that fit within their existing value universe. Even when these companies develop disruptive technologies that make use of existing components in new ways, they often seek validation from their main clients, who are not interested in the new architectures. As a result, the clients ignore the new developments, and the established company continues to focus on meeting the needs of its main clients through improvements in the established trajectory. Meanwhile, incoming companies use the existing technologies to develop new architectures, eventually intercepting the required performance path. This process provides incoming companies with advantages in manufacturing costs and design experiences that established companies often cannot match. These advantages become visible, leading to the new architecture losing its disruptive character and becoming fully competitive within markets (Christensen/Rosenbloom, 1995: 233-257).

Christensen (1997: 79, 82) suggests that the resource allocation process, involves daily decisions made by a diverse group of people to determine how to allocate personnel, money, and other resources effectively. Decisions to innovate usually come from lower levels of the organization, not necessarily from senior management. Mid-range managers evaluate proposals considering strategic and financial aspects, favoring projects with higher profitability and potential recognition. By the time proposals reach top management, lower-level decisions have already been made in favor of profitable projects, which are sustained by their representation of high margins. According to Christensen, established companies tend to rely on their existing resources and invest in improving the performance of their current technologies to meet the demands of their main market. This resource dependency can limit their ability to invest in new and potentially disruptive technologies (Christensen, 1997: 103). Disruptive technologies, on the other hand, are often ignored since they offer inferior performance in the dimensions valued by the main market. This leads to demotivation among established

companies, as disruptive innovations are established in marginal markets with low returns (Adner, 2002: 667-688). Christensen (1997: 18) contends that established companies frequently miss out on emerging market opportunities because their managers concentrate excessively on meeting the demands of their core customers, which causes them to ignore disruptive innovations. This phenomenon is often attributed to managerial inertia, as managers are trained in traditional business programs to manage organizations serving markets with established products. Christensen cites the HDD case as example of this, where senior managers failed to understand the potential of disruptive innovations due to their embedded worldview shaped by current experiences. (Henderson, 2005: 5-11; Yu/Hang, 2008).

According to Tellis (2005: 34-38), companies may fail if their management lacks a clear vision of emerging technologies and markets and is unwilling to cannibalize current resources. Christensen (1997: 58) suggests that although established companies often develop disruptive technologies due to their established marketing procedures, they exhibit incompetence when commercializing these technologies. According to Christensen, listening to clients can be problematic, as clients tend to focus on better performance within existing dimensions and may ignore evolving technologies that have the potential to displace dominant ones. Danneels (2004: 246-258) argues that established companies have the necessary R&D competence to develop prototypes with disruptive technologies but fail to market them to new customers. This highlights a lack of marketing competence in identifying and building relationships with neglected customers, and in the ability to conduct research, establish new sales channels, build reputation in different markets, and allocate resources to serve new ones.

According to Henderson (2005: 5-11), there are three fundamental causes of failure for companies facing disruptive innovations. Firstly, managers may have cognitive problems as they focus on current customers and struggle to value disruptive innovations, which affects strategic decisions. Secondly, political issues can influence decisions. Thirdly, resource allocation tends to favor projects that satisfy the most profitable clients. The author notes that organizational competence, which involves integrated routines of organizations, is critical for failing companies that face disruptive innovations. However, they fail to recognize organizational competition against the market or customer competition in a potential market that can be evaluated and that leads to appropriate decisions. Yu/Hang (2008) identify factors that contribute to failure in dealing with disruptive innovation, which can be categorized as internal organizational aspects (such as structure, culture, leadership, new product development process, spin-off or ambidextrous organization, new growth engine) and external aspects related to marketing and technology (such as context, environment, customer orientation during disruptive changes, and technological road mapping for disruptive innovation).

2.3.6 Possible Responses When Facing Emerging Disruption

Industries and businesses can take various measures to prevent themselves from being disrupted, prepare themselves better against disruption, and react effectively when facing disruption. One approach to avoid disruption in business is to allocate

resources to R&D, maintain a lead in technology trends, and establish partnerships with other companies. They can also focus on building relationships with customers, understanding their needs and preferences, and providing a unique UX. Furthermore, businesses can diversify their products and services, build brand loyalty, and establish a strong network of partners and suppliers. To prepare better against disruption, businesses can be proactive in monitoring market trends and changes, and continuously innovate and improve their products / services. They can also invest in new technologies, build flexible and adaptive organizational structures, and develop contingency plans and risk management strategies. When facing disruption, businesses can react in different ways. They can choose to defend their existing position, by improving their existing products and services, or by acquiring new capabilities and technologies. Alternatively, they can choose to compete in new markets, by diversifying their products / services, or by targeting new customer segments. Businesses can also choose to cooperate with disruptors, by forming strategic partnerships or alliances, or by investing in or acquiring disruptive startups. Companies that are flexible, take initiative, and prioritize customer needs are better equipped to weather disruption.

Companies can increase their chances of success in the digital age by consistently innovating and enhancing their offerings, creating robust connections with customers and collaborators, and creating backup plans to handle unforeseen events. Christensen (1997) highlights that clients play a role in controlling investments through resource allocation. Suitable resource allocation processes prioritize projects that meet clients' needs and discard those that do not. He offers management strategies to benefit from disruptive change based on successful cases of established companies facing new technologies, business units, or independent companies. Christensen summarizes the principles applied by managers to their advantage in the cases studied (1997: 99). According to Christensen (1997: 99), there are several principles that can be employed to capitalize on disruptive technologies. These technologies appear in small markets that are initially unattractive to established companies. These principles include recognizing that customers control resource allocation, small markets do not solve large companies' growth needs, the ultimate uses of disruptive technologies are unknown, and technology supply may not equal market demand. To capitalize on these opportunities, companies must create or acquire smaller companies that can focus on emerging markets. Additionally, targeting non-consumers may be a more effective strategy than trying to attract loyal customers from competitors. Christensen (1997) argues that disruptive technologies should be approached as a market situation rather than a technological one. Companies must seek and develop markets that value the attributes of disruptive products rather than trying to make them compete in existing markets. Established companies can take advantage of disruptive technologies by meeting the needs of underserved markets, offering simple and easy-to-use products. The business model should be disruptive, profitable, and competitive, with a cost structure and distribution system that has smaller profit margins but higher net asset turnover. The crucial aspect is to concentrate on meeting the functionality and profitability require-

ments of the marginal market while exceeding their needs. These characteristics create the motivational asymmetry necessary for disruptive innovation (Christensen et al., 2002: 22). Disruptive innovation, therefore, understood as a process, requires a set of organizational and technical capacities different from those established to satisfy traditional customers (cf. Christensen, 1997; Christensen/Rosenbloom, 1995: 233-257; Danneels, 2004: 246-258; Henderson, 2005: 5-11; Tellis, 2005: 34-38). These changes can be directed and managed by what Teece/Pisano (1994: 6) call dynamic capabilities (cf. Teece et al., 1997: 516).

Companies that have encountered disruption caused by digital platform industries have responded variably based on their resources, capabilities, and strategic objectives. One common reaction is to try to imitate or compete with the disruptor by investing in similar technology or business models. For instance, when Airbnb disrupted the hospitality industry with its online platform for short-term rentals (cf. Hijrah Hati et al. 2021; Núñez-Tabales et al. 2020; Oskam/Boswijk, 2015: 22-42), traditional hotel chains like Marriott and Hilton responded by launching their own home-sharing services. Similarly, when Uber disrupted the taxi industry with its ride-hailing app (cf. Dudley et al., 2017; Kooti et al., 2017: 574-582), traditional taxi companies launched their own ride-hailing apps to compete (Galloway, 2017: 214-220). Another reaction is to partner with the disruptor to leverage their technology or customer base. For example, many retailers partnered with Amazon to sell their products on the e-commerce giant's platform, thereby gaining access to Amazon's vast customer base and logistics infrastructure (Galloway, 2017: 13-62). Likewise, traditional media companies partnered with YouTube or other video-sharing platforms (cf. 5.2.6) to distribute their content online. Some businesses also chose to diversify their offerings or business models to reduce their reliance on a single product or market. For instance, Kodak, the camera and film company, faced disruption from digital photography (Vitton et al., 2014: 63-66) and chose to diversify into other areas such as printer ink and packaging. Lastly, some businesses chose to perform M&A to strengthen their market position or expand their capabilities. For example, Meta acquired Instagram and WhatsApp (Kumar, 2019: 321-327) to expand its social media offerings and reach new user segments. Similarly, Disney acquired 21st Century Fox to bolster its content library and expand its media empire (Chen et al., 2021).

2.4 Role, Terminology, and Analysis of Competition, Approaches, and its Dynamics

2.4.1 Competition and its Role in the Digital Platform Economy

Academic theories, such as organization economics, platform theory, and innovation and disruption economics, provide insights into the dynamics of competition in digital markets. Industrial organization economics emphasizes the role of market structure and competition policy in promoting efficiency and consumer welfare. Platform

theory emphasizes the importance of platform design and governance in shaping competition and innovation. Innovation economics emphasizes the role of innovation and entrepreneurship in driving growth and competition. Competition law and policy play a meaningful and important role when it comes to the promotion of competitiveness in the digital platform economy. Enforcement agencies must grapple with issues such as defining relevant markets, evaluating market power, and addressing the abuse of dominance. Antitrust theories, such as the consumer welfare standard and the rule of reason, provide a framework for analyzing these issues.

Competition is an essential aspect of the digital platform economy, as it drives innovation, ensures consumer choice, and regulates market power. Understanding competition in the digital platform economy requires an analysis of the unique features of these markets, such as the importance of network effects, the role of data, and the potential for winner-takes-all outcomes (Andrews et al., 2016: 12; Sun/Tse, 2007: 16-41). The digital platform economy has seen intense competition since its inception, and the rapid emergence of search engines in the late years of the 1990s marks one of the earliest examples of competition in the entire area. Google emerged as a dominant player in the search engine market (cf. Galloway, 2017: 126-156), leaving behind other search engines such as AltaVista, Yahoo, and Lycos. In the early 2000s, Microsoft entered the search engine market with Bing, but has struggled to gain significant market share. The digital platform economy has seen competition in various forms, including the emergence of social media platforms. Facebook, among other early players such as MySpace (Wilkinson/Thelwall, 2010: 2311-2323) and Friendster, emerged as a dominant player in the social media market. However, other social media platforms have emerged, such as Twitter, Instagram, and Snapchat (cf. Tilic, 2017), which have challenged Facebook's dominance in different ways.

E-commerce platforms have also witnessed intense competition, with Amazon being the most prominent player. Other players such as eBay, Walmart, and Alibaba (Galloway, 2017: 2020-221, 206-210) have tried to compete with Amazon, but Amazon's dominance in e-commerce has largely remained unchallenged (Galloway, 2017: 13-62). The ride-sharing industry has also seen intense competition in recent years, with companies such as Uber and Lyft emerging as major players (cf. Dudley et al., 2017). However, new entrants such as Grab and Didi Chuxing have also gained significant market share. The digital platform economy has also witnessed competition between traditional industries and digital platforms. For example, traditional media companies such as newspapers and television channels have faced significant competition from digital media platforms such as YouTube and Netflix (Weinman, 2015: 197-210; Green, 2023). The digital platform economy remains a very competitive and dynamic space due to the continuous emergence of new actors, agents and technologies challenging the dominance of incumbents.

One of the effects of technology is that it has lowered the barriers to entry, allowing smaller companies with fewer resources to compete with established firms. Startups can now take advantage of cloud computing, which allows them to launch products

and services quickly and cost-effectively by utilizing the infrastructure and resources of larger companies like AWS, Microsoft Azure, and Google Cloud. In addition, technology has enabled the development of new business models and strategies that can disrupt established players in the market. For instance, the sharing economy (cf. Agarwal/Steinmetz, 2019; Hamari et al., 2016: 2047-2059; Schor et al., 2015: 12-19) has disrupted traditional industries such as hospitality and transportation. Furthermore, technology has enabled firms to capture and analyze large amounts of data, allowing them to gain insights into customer behavior and preferences. This has enabled firms to create more personalized and targeted marketing strategies, as well as to optimize their operations and supply chains. For example, Amazon uses its vast amounts of customer data to personalize its recommendations and optimize its logistics and delivery processes. With the help of technology, collaboration and co-creation among firms have become easier, making it possible for them to create new products / services through open innovation.

2.4.2 Competitiveness and Competition in Literature

Since the 1980s, competitiveness has been a popular topic, considered a crucial goal for development plans and business strategies, and discussed in forums and editorials. Competitiveness is often viewed as a key element in international trade and a driving force for capitalism. Three aspects are essential to address competitiveness precisely: a company's competitive capacity, its evolution over time, and the conditions that enable its sector to develop competitiveness. These aspects involve various factors such as the sector, the country's economy, and the economic scenario that favor a company's entry and its ability to compete effectively.

Krugman (1986), Porter (1990; 1980: 122-123), Esser et al. (1996) and Bhawsar/Chattopadhyay, 2015: 665-679) have different perspectives on competitiveness. According to their interpretations, these authors focus on identifying the static scenarios that promote competitiveness in companies at a given time. Porter (1990) places the competitive company at the center of a scenario composed of the market, production process efficiency, supporting sectors, and the consolidated structure of the company. Krugman (1986) ties competitiveness to a company's productivity based on technological, organizational, and institutional innovations. Esser et al. (1996) suggest that competitiveness is based on the systemic approach where variables from micro, meso, macro, and meta-economic scenarios interact and affect a company's ability to compete in domestic and international markets, leading to success. In this work, companies are viewed as part of a dynamic sector, which provides opportunities for them to increase their competitiveness both within and outside the sector.

Previous analyses of competitiveness have primarily focused on factors within the company and its location, rather than on the perspective of the customer who ultimately decides whether to accept or reject the product or service. Competitiveness and success of a company are determined by the prevailing circumstances discussed above.

Bhawsar/Chattopadhyay, discuss the concept of competitiveness, different factors that influence it, and the methods used to measure it, highlighting the need to focus on the impact of non-economic factors on competitiveness and the importance of considering its dynamic nature. As such, competitiveness refers to the ability of economic agents to take advantage of favorable economic scenarios persistently. The concept also includes overcoming obstacles arising from discouraging scenarios.

The term competitive strategy refers to a plan or approach that a company adopts to gain a competitive advantage over its rivals in the market (McGee/Sammut-Bonnici, 2014: 4), and this involves making choices about how to allocate resources, which markets to compete in, how to differentiate the company's products / services, and how to sustain the advantages over time. The proposal of this definition is like the commonly known concept of competitiveness, which can also be associated with competition. Competitiveness is a term that lacks academic boundaries, making it both extremely precise and very generic, leading to it being a buzzword that influences economic agents and shapes social and economic realities. Competition can be considered synonymous with competitiveness in the context of competitive strategy, where actors in a particular market wage an economic struggle to gain leadership. The difference between competence and competitiveness lies in the focus on the economic agent who has the necessary skills to compete, which is the result of competitiveness.

In a closed economy, competitiveness could be described as a meditative process where great powers and capitals confront each other to accumulate wealth. In an open economy, where competition drives economic dynamics, success for companies, individuals, and even countries is heavily reliant on competitiveness. It is an essential component that allows investors, companies, and entities to achieve their desired outcomes and improve their economic situation. Competitiveness has historically been considered important for success, with countries only exporting products in which they had a comparative advantage. This implies that the foregone alternative cost of the exported commodity should have been less than the cost incurred in the country that imported it to produce the same commodity. The determinants of competitiveness have historically been based on factors such as production abundance, economies of scale, and possession of natural resources (Krugman, 1986; Bougrine, 2016: 128). Competitiveness is determined by market efficiency, price stability, and the state's encouragement to utilize factors and resources to create products that fulfill human needs. However, more recent theories of local, regional, and international trade consider the market structure and strategic behavior of companies as important factors in the value chain, making competitiveness more complex (cf. Bougrine, 2016: 105, 128).

To begin with, competitiveness can be analyzed by examining a market with imperfect competition where companies produce the same product. In such a market, there is typically a market leader who sets the standard for others to follow, regardless of their production, financial, innovation, or creative capacity. As a result, companies engage in a competitive dynamic that leads them to cover the market according to their

ability to compete. An inquiry arises regarding the factors that impact a firm's competitiveness in a specific industry within an economy. Innovation and technological development are critical factors as they allow to produce goods with features that attract consumers and optimize production factors. Additionally, factors such as organizational culture, financial structure, market coverage, and state participation in providing physical infrastructure can enhance a company's competitiveness. To determine competitiveness, companies need to pass consumer tests to gain acceptance in national and international markets. A sector can be successful in gaining competitiveness when its companies have financial, administrative, innovation, technological development capacity, and contributions in physical infrastructure to meet consumer demands.

As Porter (1990) stated, a company gains competitiveness as it gains market acceptance, resulting in positive variations in its financial structure and aggressive expansion. Competitiveness is a comprehensive scenario formed by macro and microeconomic levels in which companies interact until they become a sector's point of reference. To summarize, competition refers to the contest or competition among businesses that provide comparable goods / services to identical consumers in the same field. It can be current or future, homogeneous or heterogeneous, and can take place domestically, regionally, or globally. In today’s fast-paced, globalized economic world, global competition is increasingly important, and management must be able to handle unexpected changes and challenges to keep companies agile and efficient. Competition is not just about having many companies in the same industry, but also depends on the focus of the individual companies, such as customer orientation, market focus, quality/quantity focus, price differentiation, product differentiation (Galloway, 2017: 184-188), or service orientation (cf. Bougrine, 2016).

Porter (1980: 129-156) categorizes companies that provide similar products or services to the same customer base in a particular market as strategic groups, and these groups are in rivalry. If there are multiple companies within a strategic group or multiple strategic groups within an industry, there will be competition on various factors such as prices, advertising, and services. The more companies there are in a strategic group, the higher the likelihood of competition. Competition reduces the return on investment to a minimum level in a crowded market, and poorly performing companies are forced out, while well-positioned companies can raise capital more easily (Galloway, 2017: 188-189).

There is mutual dependency between companies that are in competition, extending to all factors of Porter's Five Forces model (1980: x). A company's competitive initiatives are driven and dependent on the reactions of other industry participants. Competitive stability in a market depends on the competitive initiatives taken by market players and countermeasures taken by other market participants. The appearance of positional re-encounters or a competitive war may reduce the profitability of the entire strategic group. Following Porter (1980: 18), competitive instability is more likely in industries with a high number of competitors, even relative strengths, standardized

products, high fixed costs (Wang/Yang, 2001: 178-185), and slow sector growth. Competitive stability is characterized by landmarks such as discount rates or legally binding price-fixing that provide stability to the industry. When such landmarks are not applicable, market participants may agree on generally acceptable rules, but must avoid illegal actions like customer or client allocation to maintain higher profitability.

2.4.3 Origins and Characteristics of Competitive Strategy

The term strategy originated from ancient Greece and was used in a military context to describe the art of command. Military strategists developed various theories for strategic planning, and the term later gained broader usage and influence in economic contexts. In this context, strategy refers to planned behavior by companies to achieve their goals. Currently, modern advancements in the field of business strategy center on two core concepts: gaining a competitive edge and implementing alterations to an organization's structure and strategy. Although these topics originated separately, they are converging due to rapid economic and social changes in the 21st century. As such, competitive strategy is critical in the digital platform economy due to its highly competitive and rapidly evolving nature. A competitive strategy is a detailed course of action that companies employ to accomplish their objectives while contending with other companies in the identical business sector. In the platform economy, firms must remain innovative and proactive to avoid disruption by new entrants or existing competitors.

Competitive strategy helps businesses to differentiate themselves from other players in the market by offering unique value propositions to their customers. This could involve leveraging a specific technology or innovation, creating a superior UX, or focusing on a particular customer segment. For example, Netflix’s strategy of providing an extensive library of content to stream on-demand has differentiated it from traditional cable TV providers and has allowed it to gain a significant share of the video streaming market (Weinman, 2015: 197-210; Green, 2023). A well-crafted competitive strategy enables businesses to adapt to market changes quickly. This is essential in the digital platform economy, where technological advancements and shifting consumer preferences can rapidly transform the competitive landscape. Companies that can adjust their approaches in reaction to market shifts can preserve their edge over competitors and remaining significant over time. Thirdly, competitive strategy can help businesses to manage risk and uncertainty by anticipating potential disruptions and preparing for them. By differentiating themselves, adapting to market changes, and managing risks, firms can maintain their competitive advantage and avoid being disrupted by new entrants or existing competitors.

In recent years, the fields of administration strategy and organizational theory (Holt et al. 1995:136; Starbuck, 2003: 143-182) have converged due to a series of theoretical and conceptual contributions. Business strategy research typically focuses on economic fundamentals, using structured methodologies to empirically verify generaliza-

ble hypotheses and identify factors for success or failure. On the other hand, contributions from social sciences and sociology focus on organizational change, adaptation, innovation, and learning, using qualitative methods to understand and explain these processes in their context. Despite their differences, both fields have converged due to rapid economic and social changes in the 21st century. The convergence of business strategy and organizational change is driven by two key factors. Firstly, the increasing technological evolution, interconnection between large networks of organizations, and integration of world markets have led to high levels of environmental uncertainty and ambiguity. Organizational change is seen as a frequent and inevitable occurrence, prompting the need to understand and influence the process of change. Secondly, the lack of stability and predictability in organizational environments highlights weaknesses in traditional models of administration strategy in practice and theory.

Therefore, a normative aspect is added to the study of organizational change to address these weaknesses. Mintzberg (1994: 107-114) argues that the inadequacy of business strategy models towards real-world features is evidenced by the decay of strategic planning. This rejection of main strategic planning models indicates the need to redefine the discipline of strategic management and its interrelation with other disciplines, ultimately leading to an approximation between economic reasoning and sociological description. The convergence of these two fields is driven by two dimensions: the increased complexity of the economic environment and its impact on firm behavior, and the focus on intra-organizational processes and resources. Theoretical models, contributions, and empirical statements are analyzed to detail this convergence.

Neoclassical economic theory fails to explain competition fully. Until the 1970s, the explanation of economic behavior of organizations relied on neoclassical Walrasian-inspired economy. However, the neoclassical firm model was insufficient to represent the real behavior of companies, which explains why classical economic analysis is not commonly applied in companies, and why it plays a secondary role in business strategy. According to neoclassical economic theory, competitive advantage, or consistently superior results, is accidental or temporary imperfection in market functioning (cf. Arnsperger/Varoufakis, 2006: 53, 5-18; Lawson, 2013: 947-983; 2021). Competitive forces, guided by market mechanisms, erode above-average profit through capital flow in search of maximum profitability. Moreover, orthodox microeconomics does not treat a company as an institution but as an individual actor with no decision-making autonomy that responds rationally to environmental changes, which in the classical conception is reduced to prices and quantities. According to neoclassical economic theory, the company is viewed as an individual actor, much like the consumer, and is represented as a function of transforming inputs into products.

This theory is based on assumptions of balance, certainty, and perfect rationality, resulting in a static analysis of decision-making processes that aims to maximize the objective function at a specific time, given certain constraints. However, this approach fails to consider the practical limits of resource conversion, asset specificity, techno-

logical peculiarities, and organizational interaction, which limits its applicability in strategic analysis. According to Teece (1984: 88), these problems represent some of the biggest obstacles to the strategic applicability of economic analysis models. Business strategy must consider dynamic characteristics, interrelationships between decisions, change, and uncertainty as essential phenomena for long-term success. Neoclassical economics, however, focuses on allocating resources between finite and known alternatives, assuming that technology and know-how are given and diffuse in a perfectly fluid way. The idea of strategy, anticipation, and planning is unnecessary and even dysfunctional in this model. Strategic behavior can be broken down into long-term, mid-term, and short-term planning, with long-term planning constituting the framework in which a company settles itself in a specific market, product range, or competitive environment. Corporate mission statements, company visions, or claims can provide long-term corporate goals.

According to Mintzberg et al. (1998: 53), the rejection of neoclassical economic theory highlights the need to redefine business strategy to consider the realities of the business environment. The authors suggest that strategies can emerge from backgrounds, circumstances, or environments, rather than being planned from the outset of a business venture (1998: 174). Strategic planning aims to position a company to achieve competitive advantages against its rivals. A long-term business strategy focuses on the future direction of a company, and it depends on the company's strengths, weaknesses, opportunities, and threats. It is an ongoing process that requires continuity and adjustments to company positions due to constantly changing competitive forces. Long-term planning is often the outcome of analysis and planning processes and considers a company's competitiveness relative to its environments. SWOT analysis is a common approach to assess a company's resources and competencies.

Having a long-term corporate strategy is essential for assessing the performance of a business, and it necessitates unwavering dedication, effective communication, and a strong focus on execution. The objective of a competitive corporate strategy is to place a company in a position that shields it from competitive pressures or empowers it to influence them to its advantage. To achieve this, a company can create barriers to market entry or mobility, or use strategic differentiation such as brand image, marketing, sales, pricing policies, specialization in manufacturing or products, technology, customer base, or service level. These strategies can help a company limit competition or gain a competitive advantage (Mintzberg et al., 1998). Companies need to determine their position in the value chain, deciding whether to integrate themselves in the production process or outsource activities that do not align with their core competencies. Positioning is critical for achieving cost leadership, differentiation, or focus on specific priorities. Pursuing multiple approaches simultaneously is challenging since each requires a well-organized effort (Porter, 1980: 250).

A product can be differentiated from its competitors by adopting a cost leadership approach. This means offering products at lower costs compared to competitors by maximizing production, purchasing and sales capacities and minimizing costs across

all organizational departments. By avoiding marginal customers and constantly controlling all attached variable and fixed costs, cost leadership can be achieved. Companies that adopt this strategy often outperform their competitors, customers, and suppliers due to their low-cost structure, making them less vulnerable to contract losses, cost increases and replacement products. However, cost leadership requires high market shares and capital investment (Galloway, 2017: 188-189), which can create entry barriers to new competitors. This approach provides protection against all five competitive forces in Porter's Five Forces Model (1980: x).

To successfully implement any of the strategies, a company must have strong internal alignment and support for its measures. Another approach to differentiate a business is by focusing on specific niche markets or target groups, such as particular customer groups, product segments, or geographic regions that are profitable. This can improve a company's efficiency through better customer focus, quicker responsiveness, or lower costs compared to competitors with broader sales approaches. However, it also increases vulnerability by relying heavily on a single market, eliminating the risk diversification that a competitor might employ across multiple segments. Differentiation is a crucial aspect of a company's competitive strategy, as it creates uniqueness and helps to build brand loyalty and above-average returns in even saturated markets. By positioning themselves appropriately, companies can strengthen their competitive position and use the five competitive forces (Porter, 1980: x) to their advantage, allowing for early reaction and adaptation of their corporate strategy ahead of the competition. Competitor reactions lead to different competitive arenas and provoke countermeasures, which can escalate competition. This mechanism, which is known as escalation ladders, can be managed by developing dynamic strategies (D'Aveni et al., 1995).

To stay competitive, it is important to anticipate the actions of competitors through competitive analysis and assess the dynamics of competition. In dynamic environments, strategies must be constantly questioned and adapted to changing conditions. While traditional strategies aim for lasting competitive advantages, dynamic strategists aim for temporary advantages by shaking up the status quo. This requires a focus on both using existing advantages and creating new ones through an understanding of industry structures and forecasting their development. By analyzing competitors, future advantages can be determined. Establishing a dynamic strategy means planning initiatives to build competitive advantages faster than the competition by defending existing advantages while establishing new, short-term advantages through resource development and timing. Successful implementation involves defending and exploiting existing advantages and destroying competitors' advantages. Dynamic strategies are relevant in industries such as automotive and mobile devices with stagnating or dynamic technology, respectively. However, in growing markets, increasing competition is likely. While lacking empirical research and specific implementation guidelines, the concept considers the creative and temporary aspects of advantages and can aid strategic corporate management.

2.4.4 Approaches for Industry Analysis and Competitive Environment

In the digital platform economy, competitive analysis plays a significant role in enabling businesses to comprehend their competitive landscape and recognize prospects for expansion and distinction. By assessing the strengths and weaknesses of their rivals, companies can more effectively position themselves and make well-informed strategic judgments. In the digital platform economy, competitive analysis goes beyond just traditional industry rivals and includes analyzing the strategies of platform giants, as well as smaller disruptors. Competitive analysis involves gathering and analyzing information about competitors' products / services, market share, pricing, distribution channels, marketing strategies, and customer demographics. Knowing the competitive landscape can assist businesses in spotting openings in the market, generating innovative products / services, and creating personalized marketing strategies. Such knowledge can enable companies to anticipate and react to market fluctuations, such as new competitors or game-changing technologies. For example, Uber's success can be attributed in part to its competitive analysis of the taxi industry (Kooti et al., 2017: 574-582). By identifying customer dissatisfaction with traditional taxis (cf. Dudley et al., 2017), Uber was able to create a new business model that offered a more convenient and user-friendly service (Galloway, 2017: 214-220). By conducting a thorough analysis of the hotel industry, Airbnb was able to develop a platform that provided travelers with a distinctive and tailored way of exploring new destinations (Hijrah Hati et al. 2021; Núñez-Tabales et al. 2020; Oskam/Boswijk, 2015: 22-42).

Competitive analysis involves identifying the reasons and characteristics of competitive forces, and their impact on the industry's profitability. Porter's Competitive Strategy (1980) outlines a two-step approach to analyze industry competitiveness: a structural analysis from a global perspective, followed by a detailed industry analysis. Comparing a company to the entire industry is essential, as dominant forces are related to the industry landscape. Porter's model (1980: x) is useful for early-stage strategic analysis, enabling better assessment of risks and opportunities. Competitive analysis supplements structural analysis in planning market positioning and predicting industry conditions. It also allows for the assessment of potential reactions within the competition and provides entrepreneurial clarity on future initiatives, such as launching a new product.

Porter's (1980: x, xv) Five Forces is a proven method for analyzing industry structure in strategic management. It assesses the attractiveness of an industry by evaluating five factors: supplier and customer bargaining power, the threat of new competitors and product substitutes, and competitive intensity. By using this model, companies can analyze an industry's structure and competitive situation within it in a systematic manner. This analysis helps to determine whether the industry's environment is favorable to the company and if it has the potential for profitable long-term growth. The model assumes that the market structure influences the strategic behavior of compa-

nies and their competitive strategy, which ultimately affects their market success (Porter, 1979). In this way, a company's success depends on the overall market structure in which it operates.

The entry of new competitors can threaten an industry by increasing competition through the introduction of similar products / services. This leads to a struggle for market share, customers, and resources, which can lower the profit margin for all competitors. The ease of entry for new competitors is affected by existing entry barriers, and the higher the barriers, the more secure the position of existing competitors becomes. Porter (1980: 9-37) categorizes several kinds of barriers to entry that can be employed by established companies to establish a more advantageous market position (cf. Lieberman/Montgomery, 1988). The entry of new competitors into a market poses a threat to existing players. New entrants face several challenges, including economies of scale, absolute cost disadvantages, product differentiation (Galloway, 2017: 184-188), switching costs, access to distribution channels, capital requirements, and state influence (Porter, 1980: 9-37). These entry barriers make it difficult for new players to enter the market, creating a more secure position for established competitors. Additionally, government regulations can also hinder new entrants in certain industries. When a new competitor enters a market, their success depends on factors like the industry's growth potential, competition from incumbents, and existing barriers to entry. Industries that are young, growing, and not dominated by large companies are more attractive for new entrants.According to Porter (1980: 9-37), the critical product price for entry is an important factor for new entrants. If the price is too low, there's little incentive for new competitors to enter, while prices above this threshold lead to more promising prospects for new entrants. However, new competitors also face challenges like increased pricing pressure, a less favorable supply-to-demand ratio, and the need to lower prices to attract customers, which can reduce industry attractiveness. The digital platform industry has a relatively high possibility of new entrants, as the obstacles or hurdles to entry are, in comparison, relatively low. New platforms can be created and launched quickly and at relatively low cost. Additionally, there is a large market for digital platforms, meaning that new entrants have the potential to quickly gain a significant share of the market.

The possibility of a company, either new or existing, to introduce alternative products has the potential to undermine the profits of a particular company or even the whole industry. Factors such as price-performance ratio, image, quality, and customer perception of the replacement product can influence this threat. Customer changeover costs and settings for the replacement products must also be considered. The more substitutes available in an industry, the more important they become, and substitutes may address different customer needs or groups, be distributed in different regions, or be complementary products that increase value when sold together. High profits for the manufacturers of replacing products can increase the threat of substitutes due to economies of scale, larger advertising budgets, or increased sales forces. The availa-

bility of substitutes diminishes the attractiveness of an industry, as customers can always switch preferences and buy substitutes as needed. Complementary products, such as e.g., a software as well as an item of hardware, are influential in the technological business environment as customers are more likely to acquire advanced software when supportive performance hardware is available. The threat of substitutes in the digital platform industry is relatively high, as there are multiple platforms that offer similar services and consumers can replace conventional offline services with digital platform services in certain situations.

The influence of customers and suppliers' bargaining power determines the degree of their importance in a company's business partnerships. If customers have high bargaining power, they can demand lower prices or better quality, which can lower a company's profitability. Indicators of high customer bargaining power include little product differentiation Porter (1980: 9-37), low switching costs, availability of substitutes, high customer concentration, and more. On the other hand, suppliers with high bargaining power can demand higher prices or provide lower quality, which can also lower a company's profitability. Indicators of high supplier bargaining power include supplier concentration, no alternative competitors, dependency on the supplier's product, barriers to exit, and more. These powerful suppliers can reduce industry profitability if pricing increases can't be passed onto customers. The less bargaining power customers and suppliers have, the more attractive the industry is for companies. Suppliers in the digital platform industry hold relatively low bargaining power since the platforms typically do not depend on external suppliers for their main business activities. However, some platforms may rely on third-party providers for additional services, such as payment processing or hosting, which could result in these suppliers having higher bargaining power. Conversely, buyers in the digital platform industry have a higher bargaining power since users have options to choose from when selecting which platform to use. Thus, platforms must strive to differentiate themselves to attract and retain users.

Industry rivalry refers to the competition between companies that offer similar products to the same customer base in the same market segment. This competition can result in lower prices or better-quality products, which can decrease the profitability of the industry. Porter (1980: 9-37) highlights several factors that affect the intensity of competition in an industry, including the number of competitors, the rate of industry growth, the presence of overcapacity, fixed costs, barriers to market entry and exit, and the level of product differentiation Porter (1980: 9-37). In industries with low competition, companies can expand their sales volume without losing market share. On the other hand, in industries with high competition, companies must protect themselves by establishing barriers to entry and exit, differentiating their products, and managing capacity utilization to achieve high profitability. The intensity of competitive rivalry in the digital platform industry is high, as multiple platforms offer similar services and are competing for users. Platforms must work to differentiate themselves through features, user experience, and other factors to gain and retain market share.

Porter's Five Forces model (1980: x, xv) has been criticized for its static nature and inability to capture rapidly changing environments (cf. e.g., Bose, 2007: 510-528). The model considers the combined strength of the five forces and additional factors to determine an industry's profit potential, which is expressed as a long-term ROI. The stronger the cumulative threat posed by these forces, the less attractive the industry becomes for competitors, making it difficult to sustain a competitive advantage. However, the maximum profit potential varies across industries. It is important to consider additional factors beyond Porter's model, such as government actions, which can affect each of the forces. Governments can act as customers or buyers, control the emergence of replacement products, and regulate or stimulate competition through licensing, import tariffs, or export limitations. Regulatory intervention can be found in key industries such as energy production.

Karagiannopoulos and colleagues (2005: 70) updated Porter's Five Forces model (1980: x, xv) by including innovation as a key driver and a sixth force. Innovation is important in relation to product, process, market, or organization, and helps companies adapt to fast-moving changes and increased competitiveness. Assessing innovation potential (Karagiannopoulos et al., 2005: 66-76) is crucial for companies to maintain competitiveness, and expedited technological development allows for faster and more diverse innovation. Companies need to develop flexible processes and adapt to new scenarios to remain ahead of the competition. Cooperation between competitors can lead to higher competitive advantage through shared production costs and different solutions for new business opportunities. However, dependency on a partner can create problems and result in competition. It is crucial to consider customer readiness, as the speed of technology adoption often depends on their confidence and comfort with new technology. Customers more technologically adept are more likely to adopt new technology, while those less ready may be frustrated and less willing to adapt.

In recent times, the theory of competition has undergone several advancements, notably in relation to the digital platform domain. One key development is the growing recognition of network effects and their implications for competition. Network effects can create winner-takes-all dynamics (Sun/Tse, 2007: 16-41; Andrews et al., 2016:12) in which a single dominant platform captures most of the market. Another recent development is the increasing focus on multi-sided markets, which have unique characteristics and require new analytical tools for competition analysis. The significance of data and its involvement in competition is an area that has recently gained recognition and seen growth. Data can be an asset that confers a competitive advantage on firms that possess it, and data-driven network effects can reinforce market dominance. This has led to discussions about the role of data in competition policy, including issues related to data access and privacy, and antitrust enforcement. Finally, there has been increasing attention to the role of innovation in competition. In particular, the rise of digital platforms raised questions about whether traditional measures of competition, such as market concentration, suffice to capture dynamics of innovation-driven competition. The evolving nature of modern markets, particularly in the context of the digital

platform economy, has resulted in demands for new frameworks and analytical tools to evaluate competition.

2.4.5 Conceptual Approaches to Competitive Advantage

Various economic schools of thought have discussed competitive advantage using different approaches. Some contemporary trends do not prioritize business strategies, such as neoclassical economics and approaches (cf. Arnsperger/Varoufakis, 2006: 53, 5-18; Lawson, 2013: 947-983; 2021). Theories in business strategy can be represented by four groups: 1) structural industry analysis (such as industrial organization and positioning analysis), 2) resources and skills (resource theory), 3) market processes, and 4) dynamic capabilities theory.

The new industrial organization model is a popular way to analyze competitive advantage. It's based on SCP (Structure-Conduct-Performance) analysis (McKinsey & Company, 2022), which was pioneered by Mason/Bain (1959). The SCP model suggests that a firm's performance in a specific industry depends on the behavior of buyers and sellers, such as pricing, cooperation, competition, R&D, and advertising. This behavior is defined by the industry's structure, including the number and size of competitors, product differentiation Porter (1980: 9-37), entry barriers, and vertical integration (cf. Galloway, 2017: 194-195). The SCP model assumes that a firm's economic performance is a result of its competitive behavior and industry structure. Mason and Bain developed their works to analyze oligopolies and monopolies and propose anti-trust policies. Porter and others used the model to develop business strategies that benefit companies instead of regulation. Researchers often ignore the organizational aspects of business strategy and focus only on industrial structure (Foss, 1996: 1-24).

Porter's analysis (cf. 1980: 93, 110) of competitive advantage emphasizes the key aspects of the new industrial organization model. The industry is the focus of analysis (Porter, 1991: 99), not individual firms. The structure of the industry determines the behavior of economic agents, which in turn affects the performance of firms. Porter believes that the position of the firm within the industrial structure is the primary determinant of its success or failure in the competitive scenario. Porter's views on the significance of a company's actions are noteworthy, as they shape its approach and competitiveness (1991: 100). The efficient execution of these activities allows a company to achieve lower costs or to generate differentiated value for buyers. Competitive advantage is determined by the initial conditions and the choices made by managers. The initial conditions refer to the assets accumulated by the company over time, which are derived from its relationship with the external environment. According to Porter's model, a company's strategy involves positioning itself within its industry and environment to protect itself from competitive forces (Porter, 1980: 4-6). To achieve this, a firm must establish barriers to entry and create mechanisms of tacit agreement with other economic actors in the industry, especially in industries close to monopolies or oligopolies. Strategy is therefore focused on external and internal adaptation, which involves

identifying the most favorable position in the industry and configuring the firm's internal activities to support and complement each other. A successful strategy requires coherence and synergy among a firm's activities. (Porter, 1980; 1991: 95-117; 1996: 61-78).

Several strategy approaches have emerged from industrial organization concepts. One of these approaches focuses on committed competition (Ghemawat, 1986: 53; 1991) and identifies sustainable competitive advantage through irreversible investment decisions that signal the closing of opportunities. Another contribution comes from game theory (Shapiro, 1989: 128), which models the behavior of firms based on industry structural variables to add a more dynamic dimension to strategy. However, the accuracy of the models in reflecting actual company behavior depends on shared premises among actors, making game theory more successful in explaining the behavior of mature and stable industries with symmetrical strategies and no frequent discontinuities in competitor relationships. Consequently, Porter's business strategy paradigm (1980: xviii; 1996: 61-78) has been widely accepted due to its consistent and empirically verifiable framework that predicts the behavior of companies in real cases. However, it was criticized for giving secondary importance to intra-organizational processes. The focus is on the industry as unit of analysis, with firms seen as a set of organized activities, with differences reduced to size and positioning.

Additionally, theories of industrial economics rely on strong premises of economic rationality close to neoclassical economics (cf. Arnsperger/Varoufakis, 2006: 53, 5-18; Lawson, 2013: 947-983; 2021), if managers can fully and objectively analyze all relevant aspects of the industry and optimize their strategies. This perspective turns the strategy into a continuous effort to adapt ex post to uncontrollable external forces, which limits its effectiveness. Recent advancements in the digital platform economy indicate that conventional sources of competitive advantage, such as economies of scale, brand recognition, and exclusive technology, may not be enough to sustain a competitive edge. Instead, firms are increasingly turning to network effects, data-driven insights, and platform orchestration (cf. Isckia et al., 2020) to initiate an advantage. The act of platform orchestration refers to utilizing the platform to synchronize and link supplementary products / services that are being provided by e.g., external suppliers. By doing so, firms can expand the range of services offered to users and capture a share of the value created by the third-party providers (Isckia et al., 2020: 197-223).

2.4.6 Resources, Competencies and Capabilities

The resources and competencies approach emphasizes that a firm's internal resources and capabilities play a critical role in determining its competitive advantage and long-term success. In the digital platform economy, it is crucial for businesses to utilize their capabilities and resources to gain a competitive edge and set themselves apart from their rivals. In this approach, resources refer to tangible and intangible assets that a firm possesses, such as financial resources, technology, and brand repu-

tation, while competencies refer to the firm's ability to utilize those resources effectively, such as management expertise, knowledge, and skills. In the digital platform economy, companies must develop and leverage resources and competencies in areas such as data analytics, user experience design, and software engineering to first create and then, subsequently, maintain a competitive advantage.

For example, companies like TikTok (Miltsov, 2022: 664-676) have built their competitive advantage by developing highly sophisticated algorithms that enable them to deliver relevant content and advertising to users. Similarly, Alibaba has leveraged its vast amounts of customer data to develop highly personalized product recommendations and supply chain efficiencies that enable it to deliver products more quickly and efficiently than its competitors (Galloway, 2017: 206-210). The resources and competencies approach also emphasizes the importance of continuous innovation as well as learning and evolving. Companies do have to be able to adapt and evolve their resources and competencies to keep pace with rapidly changing technologies and user needs. For example, Disney+ has continued to invest in its data analytics capabilities to improve its content recommendations and user experience, while also developing original content to differentiate from competitors (cf. Soares et al., 2022: 195-206).

The set of ideas that was conventionally called resource theory appeared during the 1980s as an alternative to the dominant position of the industrial organization. The central proposition of this trend is that the source of competitive advantage is found primarily in the resources and skills developed and controlled by companies and only secondarily in the structure of the industries in which they are positioned. Firms are resource bundles (Wernerfelt, 1984: 175) or, according to Prahalad/Hamel (1990: 81), as sets of skills and capabilities. These resources and capacities are seen as rare elements, of difficult and costly imitation and replacement within the framework of a particular organization (Barney, 1991: 100; 1997). The idea of resources includes not only physical and financial resources but also intangible (Hall, 1992: 135-144) or invisible (Itami/Roehl, 1987) resources. The recent origin of resource theory is usually associated with the work of Wernerfelt (1984: 171-180), however, several older theoretical contributions paved the way for its constitution.

One of the pioneering contributions in characterizing organizations as entities that build specific resources through the institutionalization process can be found in the work of Selznick (1957: 55-56). He describes the process in which an organization transforms from a mere instrument to the realization of a particular set of values. Selznick (1957: 55-56) shows that organizations, through the strategic choices they make, acquire an individual character. Penrose (1959) made a major contribution to the theory of resources by conceptualizing the firm as a group of resources. Her work focused on the growth of companies and viewed firms as administrative entities rather than just abstract functions of transforming inputs into products. The firm's expansion is driven by both internal and external opportunities, with an emphasis on the limits and possibilities that internal resources place on growth. This recognition of heterogeneity values the organization's learning process, and the demand for full resource utilization keeps

firms and markets from achieving balance. Thus, even if industry and competition are stable, firms try to optimize the use of their resources and move away from equilibrium.

Resource theory has several groups of precursors, including the school of strategic design. Andrews (1980) proposed the SWOT analysis model, which shares some of the fundamental concepts of resource theory. The SWOT model analyzes an organization's strengths and weaknesses internally, based on its unique resources and competencies, and its opportunities and threats externally, based on the competitive and demand conditions. Andrews (1980) contends that the strengths and weaknesses of an organization are a result of the strengths and weaknesses of its individual members, as well as how these abilities interact in a team context and the effectiveness of coordination among them. This perspective aligns closely with resource theory's view that an organization's competitiveness relies on its capacity to select and combine complementary resources. The theory of resources relies on two empirical generalizations and two postulates (Foss, 1997: 3-18). The first generalization is that firms differ in their ability to control resources necessary for their strategies, and this difference is stable over time (cf. Nelson, 1991: 61-74). The second generalization is that firms constantly seek to improve their economic performance. These findings challenge traditional economic theory and assumptions of the general equilibrium of the economic system. The postulates state that differences in resource endowments cause differences in performance and that resources must generate marketable products or services to justify differences in performance. This breaks away from theories that attribute differences between firms to external factors, such as their industry position.

Barney (1997) argues that resources vary in their ability to generate value for customers or facilitate the execution of distinctive strategies. This view shifts the emphasis of competition from products to resources and capabilities (Sanchez/Heene, 1996: 1-35; Hamel, 1994: 11-33). Resource theory suggests that firms with heterogeneous resource endowments exhibit differences in economic performance, with some showing low profitability and others exceptional profitability above the market average. This competitive advantage is due to the limited supply of resources that are rare and difficult to imitate, either due to structural or behavioral factors. The inelastic supply of these resources can generate above-market-average profits if competitors cannot access them or find substitutes. To prevent erosion of profits, imperfect imitability and imperfect substitutability are analyzed (Peteraf, 1993: 179-191).

Resource theory explains that firms with unique and difficult-to-replicate resources have a competitive advantage and can earn profits above the market average. Two mechanisms that prevent this advantage from being eroded are imperfect imitability and imperfect substitutability. These mechanisms create an isolation system from competition and guarantee the heterogeneity of resources and associated incomes (Rumelt, 1984). Factors that make it difficult to imitate competitors include natural, legal, institutional, economic, and organizational factors. These factors include the tacit nature of resources (Reed/Defillippi, 1990: 88-102), the unique historical conditions for the implementation of skills / resources (Barney, 1997; Arthur, 1989: 116-117), the

causal ambiguity and the complexity of resources (Reed/Defillippi, 1990; Barney, 1997), the advantages of asset masses and their degree of erosion (Dierickx/Cool, 1989: 1508-1509), and the availability of substitutes for these resources.

For a firm's specific resources to generate above-average income, it's necessary that they can't easily be transferred to another firm. Perfect mobility of resources would remove exceptional profits as they'd be included in general prices through the factor market. While factors like capital, machinery, and patents are limited by physical characteristics and property rights, much of a firm's resource value isn't captured by market prices and is immovable due to firm-specific characteristics. Resource interdependence and contextual dependence on the firm's skills and know-how cause market imperfection, limiting competition. Imperfect resource markets are a necessary condition for competitive advantages to exist. If resources were transferable among firms, they'd be evaluated as a factor of production like other inputs, and the average return on capital/resources would be equal to the market average.

The existence of imperfect resource markets is necessary for competitive advantages to exist (Barney, 1986: 1231-1241). The success of a firm in generating profits above the average market level depends on the difficulty of transferring its resources to competitors. Resource markets are incomplete and imperfect, meaning that certain resources cannot be bought or sold, leading firms to develop specific resources internally (Dierickx/Cool, 1989: 1505). The imperfections and incompleteness of resource markets create differences between firms, and managers' decisions (refer to Selznick, 1957) interact with past decisions, creating irreversibility and imposing restrictions. The corporate history matters when it comes to the development of a firm's resources (Arthur, 1989: 117). These conditions are necessary for firms to maintain competitive advantages and ensure the continuity of resource heterogeneity.

Resource markets are incomplete, and a significant portion of resources cannot be bought or sold, which makes it necessary to accumulate them within the firm. This internal accumulation is essential to ensure the specific character of a firm's set of resources, and it guarantees the continuity of the heterogeneity of resources. Resource theory highlights the differences between firms due to the diversity of their resource and competency bases, which are developed through the diversity of choices and commitments of the managers of the firms. The management of the processes of accumulation, coordination, and diffusion of resources becomes the primary function of business administration (Prahalad/Hamel, 1990: 87). The idea that resources should guide strategy more strongly than the constraints of the external environment (cf. Barney, 1986: 1231) is also central to numerous theoretical elaborations about the corporate aim for diversification (Barney, 1997; Collis, 1991: 49-68; Grant, 1991: 133). It is the asymmetry of information regarding the potential of the firm's specific resources and skills that should guide the strategy as it is the only possible source of competitive advantage. This approach has limits (cf. Foss, 1997: 3-18), such as the emphasis on balance, discrete resources, and the secondary role attributed to the environment.

Resource theory is connected to neoclassical ideas of rationality, economic behavior, and market stability (Barney, 1997: 171) and predictability (Foss, 1996: 1-24; 1997: 3-18). However, when dealing with uncertain and complex environments, such as emerging, fragmented, or internationalizing industries, changes in context can threaten the survival of firms. In such cases, Schumpeterian (Schumpeter, 2003) competition can emerge, which can change the economic structure of the entire industry, leading to the sudden emergence of new strategies, organizational forms, and skills. A second limitation of resource theory is its focus on discrete resources (Grant, 1991: 131), which can prove problematic since the specific character of resources is often found in their configuration. Finally, approaches centered on resource theory prioritize inside-out strategy and overlook the importance of external conditions. Authors such as Wernerfelt (1984), Collis (1991), and Ghemawat (1991) have pointed out that strategic analysis should recognize both the firm's resource-based and product-based views when detailing their strategic analysis.

The resource-based perspective emphasizes the significance of a company's internal resources and capabilities in maintaining a competitive edge. Companies can generate value and attain a competitive advantage by possessing resources and capabilities that are valuable, rare, difficult to imitate, and cannot be replaced by other alternatives. Organizational resources refer to tangible and intangible assets that a firm owns and controls, such as patents, trademarks, physical capital, financial resources, and human resources. Capabilities, in contrast to resources, refer to a firm's ability to execute a set of coordinated activities effectively using their inherent resources. The role of the organization is to develop, acquire, and integrate resources and capabilities to creating value and achieving a competitive advantage. The organization must also be able to protect its resources and capabilities from imitation and substitution by competitors. For example, Microsoft's search algorithm is a key organizational resource and capability that has enabled the firm to compete in the search engine market and the company has also developed strong human resource capabilities in hiring and retaining top talent in the field of data science and AI. Organizational resources and capabilities can also be leveraged to pursue new opportunities and create new markets (e.g., Amazon's AWS, Apple's iTunes platform, cf. Walter/Hess, 2003: 541-546).

2.4.7 Dynamic Capabilities in Complex Economic Environments

A group of authors aimed to develop a theory of organizational competencies in complex and rapidly changing environments. The synthesis in this chapter emphasizes the co-evolution between the competitive environment and the resources of firms (Amit/Schoemaker, 1993: 33-46; Sanchez et al., 1996: 85-98; Teece et al., 1997) and studies the mechanisms and processes that explain the accumulation and configuration of firms' resource bases (Dierickx/Cool, 1989: 1504-1513; Teece et al., 1997; Sanchez et al., 1996). This model analyzes the relationships between decision-making processes, actions taken, and managerial consequences on the formation, conservation, and destruction of resources. Hogarth et al. (1991: 7) identified four sources of

competitive advantage based on specific types of resources. The first source is privileged access to unique resources, such as patents or rare resources. The second source is the ability to transform production factors into salable products using distinctive capabilities or processes accumulated over time. The third source is the leverage of resources and capabilities to renew the firm's stock of resources and skills. The fourth origin of competitive advantage is the capacity to generate a steady stream of innovations by continually reconfiguring the company's resource base. While the first two sources are stable and discrete resources, the last two are dynamic and require a process of renewal. According to Teece et al. (1997: 515), the identification of all four sources is necessary to explain a firm's long-term competitive advantage.

Relying solely on resources and static capacities can lead to risks such as overspecialization (Miller, 1992: 37-41) and rigidity in firms' competencies and resources (Leonard-Barton, 1992: 116, 118). Resource theory treats resources and capacities as fixed variables, which is necessary to realize Ricardian rents (cf. Sautet, 2014). However, dynamic capabilities are more important in generating additional sources of income through the accumulation and combination of new resources in new configurations. The accumulation of resources is the result of the routines and processes of the firm (Teece et al., 1997: 518), which fulfill three functions: coordination/integration, learning, and reconfiguration. Dynamic capabilities theory aims to build a theoretical framework that considers the relationship between the cognitive structures of economic agents and the strategic decisions of firms (Sanchez et al., 1996: 85-98). Sanchez/Heene (1996: 15) propose that dynamic capabilities go beyond the traditional resource-based view of the firm, which emphasizes the importance of assets and their management, by also incorporating aspects such as managerial cognition, coordination, and process management in relation to a firm's competencies. By emphasizing organizational processes, a more adaptable strategic theory is created compared to economic views that treat resources as fixed elements. The dynamic capabilities approach considers environmental factors that were previously overlooked in the resource-based view, thereby enhancing the strategic decision-making process.

Traditional competition between firms has been focused on analyzing markets and products, but the notion of competition based on the competencies of firms (competence-based competition) has emerged. This approach considers unique or rare resources that come from firm-specific organizational processes and allows for the dynamic evolution of a firm's resource endowments. Environmental changes often require companies to regenerate their base of resources and skills. Anticipation of these transformations in the resource portfolios is critical for companies to maintain their competitive advantage (Amit/Schoemaker, 1993: 36; cf. Prahalad/Hamel, 1990: 79-90). In hypercompetitive and turbulent environments, firms need to continually redefine their resource bases (cf. D'Aveni/Gunther, 1994) and strengthen their competencies to develop broader strategic resources capable of allowing rapid modification of the firm's resource base. The dynamic capabilities theory recognizes that not all competencies are equally important for competitive advantage and that a firm can only excel in a

limited number of core competencies. Organizational learning and tacit knowledge play a determining role in identifying and developing these core competencies through knowledge acquisition and structuring at the organizational level Henderson/Clark, 1990: 9-30; Leonard-Barton, 1992: 111-125).

As demonstrated, several theoretical perspectives have recognized the importance of knowledge and technology for companies' performance. Resource theory and the dynamic capability's view suggest that a firm's resources and capabilities result from a learning process and the collective actions available to the firm. Core competencies reflect the firm's tacit knowledge derived from its specific resources. The chain of dynamic capabilities acknowledges the constraints of the current resource base and the firm's history but seeks to explain how firms can proactively or reactively reconfigure their resource base given the uncertainty and instability of the competitive environment in the long run (cf. Teece et al., 1997: 514-515). As such, the dynamic capabilities approach is an important theoretical framework in strategic management that is used to explain how organizations can develop and leverage their resources and capabilities to adapt to changing environments and achieve sustainable competitive advantage.

The dynamic capabilities approach is especially applicable in the context of the digital platform economy, where technology is continuously evolving and causing disruptions to established business models. One key aspect of the dynamic capabilities approach is the idea of sensing and seizing opportunities. This involves being able to recognize new opportunities and potential threats, and then taking action to exploit or defend against them. In the digital platform economy, companies developed dynamic capabilities that center around data analytics, which enables them to rapidly sense changes in customer behavior and market trends and respond with new services. The capacity to reconfigure resources and capabilities in response to changing circumstances is critical, e.g., by developing dynamic capabilities around open innovation.

2.4.8 Hypercompetition in the Digital Platform Industry

Hypercompetition is a concept originally proposed by D'Aveni (D'Aveni et al. 1995; D'Aveni/Gunther, 1994) that can explain the highly dynamic and intense competition that takes place in the digital platform economy. In this context, companies must engage in a continuous cycle of strategic moves and countermoves to gain and maintain competitive advantages. Hypercompetition is characterized by rapid and unpredictable changes in markets and technologies, emergence of new competitors, and erosion of the somewhat more classic or traditional sources of competitive advantage. To succeed in this environment, companies must be willing to take risks, experiment with new business models, and constantly innovate.

According to D'Aveni and Gunther (1994), competition is based on four main areas: price and quality, timing and know-how, industry entry barriers, and financial liquidity. Pricing wars are often the starting point for cost and quality competition, in which companies lower prices to gain market share. This can lead to a position of cost leadership

or differentiation. Innovation and quick market penetration become crucial for companies to succeed in this competition. As companies move towards optimum value, a new cycle of competition begins, where innovation becomes the focus. However, in the long term, there are no lasting advantages through price and quality competition. The competitive process starts with a company introducing an innovation that opens a new market segment. Established companies observe its success and, if it is successful, begin imitating it. Imitator position improved products while avoiding high initial development costs. Innovators try to protect their advantages with patents or exclusive contracts, but these barriers are eventually overcome. The competition is based on expanding a resource base and choosing the right time for innovation. Entry barriers protect companies from new competitors, but these protections are only temporary. Once a global industry has emerged, competition shifts to financial strength, with larger corporations driving out or controlling small competitors. Innovations no longer provide competitive advantages due to fast imitation cycles and a quick alignment of competitive positions.

Intense industry competition can lead to an unfavorable economic environment where attempts to attract customers can trigger immediate reactions from competitors, preventing sustainable advantage. D'Aveni et al. (1995), in a hypercompetitive environment, players strive for knowledge and first-mover advantage, despite technological and global challenges. This is especially applicable to the industries of technology and media, where the benefits of scale and the ability to distribute products / services digitally without limits are coupled with the freedom of being able to operate from any location. Hypercompetition can lead to improved individual performance, but some companies may struggle to keep up. Short-term advantages, me-too approaches, and pricing wars are common in the fast-moving tech industry, where companies strive to disrupt markets and technologies. According to the Hypercompetition framework (D'Aveni/Gunther, 1994), companies can navigate hypercompetition by focusing on stakeholder satisfaction, strategic planning, positioning, shifting rules, signaling intent, and simultaneous and sequential strategic thrust.

Technology plays a critical role in facilitating hypercompetition in the digital platform economy as it enables the rapid distribution of information, allowing competitors to quickly identify and respond to new opportunities and threats. This results in a situation where a single platform dominates the market and smaller competitors struggle to keep up, due to the combination of economies of scale, unlimited digital distribution, and the ability to collect vast amounts of user data. The platform's access to such data can be used to create more personalized and targeted services, making it harder for smaller competitors without similar resources to succeed. Moreover, technology facilitates rapid innovation cycles, which can create difficulties for traditional incumbents who may lack the agility or resources to respond quickly to market changes. This is particularly relevant in technology and media sectors, where location independence further contributes to this dynamic.

The digital platform economy is particularly susceptible to hypercompetition due to its low barriers to entry and the ease with which new competitors can enter the market. As a result, companies must continuously innovate and adapt to stay ahead of the curve. This often involves engaging in strategic partnerships and alliances, as well as M&A, to gain access to new technologies and markets. Besides these strategic actions, firms must also possess a high degree of flexibility and adaptability to promptly adjust to changes in the market. This requires a culture of experimentation and a willingness to fail fast and learn quickly. Companies must be adept at leveraging data analytics to gain insights into customer behavior and preferences, and to identify emerging trends and opportunities.

Examples of hypercompetition in the digital platform economy can be seen in the ride-sharing industry, where platforms compete for drivers and customers by offering lower prices, better incentives, and improved services and by engaging in aggressive marketing campaigns to attract new customers, such as offering free rides or discounts, or in the e-commerce industry, where platforms engage in price wars and invest heavily in the improvement of their logistics and their supply chain management in order to eventually improve their efficiency and also to reduce their occurring costs. In relation to social media, Twitter, TikTok, and Snapchat (cf. Tilic, 2017) all compete for user engagement and advertising revenue, constantly updating their platforms with new features and engaging in aggressive advertising campaigns to attract new users and advertisers, while in the cloud computing industry hypercompetition can be observed in relation compete on price, features, and scalability to attract customers, such as businesses and governments.

3 ANALYSIS APPROACH

3.1 Approaches in Literature for the Understanding of Technology in Economy

Views on technology, its characteristics, and its role are varied and complex. The relationship between technology and the economy has been analyzed by a variety of disciplines and authors from critical perspectives. The political economy of communication perspective, represented by e.g., Smythe (1981: 497-515), Schiller (1984: 382-383), Mosco (2008), or McChesney (McChesney/Nichols, 2016) argues that the media and communication technologies are not neutral, but rather are shaped by the economic and political interests of those who control them. This perspective views the media as a site of struggle over power and resources. Technological determinists argue that technology is the primary driver of social and economic change and believe that technological progress is inevitable and autonomous, that society must adapt to it, and that technology is a neutral force that can be used for good or ill, depending on how it is applied. Key proponents of this view include McLuhan (1994), Ellul (1967), and Mumford (Williams, 2002: 139-149). Ellul (1967: XXV) emphasizes technology's power and role in creating a mechanized society.

Weber (1978) distinguishes between technique and technology, defining the former to achieve a goal and the latter as a resource for human action. He identifies four modes of determination that exist in every form of action, with end-oriented actions exhibiting the strongest connection between means and ends. Rationality marked the evolution of Western society, leading to the domination of technique and the development of bureaucratic models for organizing society, with the critical aspect being the entrepreneur's control (cf. Weber, 1978: 1401). Bunge (2007: 245-272), similarly, views technology as a set of practices, with science providing theoretical knowledge and technology founded on practical knowledge. The technologist applies scientific methods to practical problems while the technician applies developed techniques to work, which can be beneficial, harmful, or ambivalent depending on the context of use (Bunge, 2014). The direction of innovation depends on policy decisions and the actions of technologists, and research is closely linked to economic activities and culture.

Evolutionary economists emphasize the importance of institutions and networks in supporting the development and diffusion of new technologies (Witt/Chai, 2019). Economists, such as Schumpeter (1934; 2003), Nelson (1991: 61-74), or Winter (Nelson/Winter, 1977: 215-245), view technology as a key driver of economic growth and development, believing that technological progress is a result of cumulative knowledge and learning, and that innovation is driven by competition and entrepreneurship. Institutional economists view technology as embedded in social and institutional contexts (Rutherford, 2001), and emphasize the importance of institutions in shaping technological change. This current believes that the development and diffusion of technology is influenced by factors such as property rights, regulation, and cultural norms, emphasizing the importance of path dependence in understanding technological change, arguing that history of technology shapes its future development. Institutional scenarios

play a significant role in accelerating or delaying technological changes, technical progress depends on knowledge and existing technologies.

The environment for technical progress is characterized by market dynamics, uncertainties, asymmetries, and variations (Dosi et al., 2005: 678-702). The evolutionists' approach involves examining the relationship between technology and the economy, with a focus on the concept of innovation as a driver of technical evolution (Nelson/Winter, 1977: 215-245). During each cycle of technical changes, existing products rise and conflict with previous innovations, institutions, management, and regulations, and financial capital plays a crucial role in driving innovation (cf. Galloway, 2017: 188-189). Mandel examines the relationship between economic development and technology using Kondratiev's long wave theories (Grinin et al., 2012), suggesting that economic phases, marked by factors such as increased surplus value and capital circulation, create conditions for expansive cycles that encourage innovation, which tend to occur during moments of expansion rather than stagnation when profits expectations are low (Mandel, 1995). These serve as sources of profit that entrepreneurs exploit before the market stabilizes. Mandel (1976) identifies a significant change in this cycle, characterized by increased mechanization of production, circulation, and superstructure, and the introduction of electronic devices, which represents the full industrialization of all economic sectors for the first time (Mandel, 1976: 191).

According to scholars in science and technology studies, technology is not an objective or neutral entity, but rather a product of the social as well as cultural factors that influence its development and use. They argue that technology is not deterministic, but rather is shaped by a varied range of social, cultural, and political factors. Key authors in this tradition include Latour (1988; 1993), Haraway (1991: 149-181), Jasanoff (2002: 253-276), Winner (1986), and Pickering (2018). Actor-Network Theory (ANT), developed by Latour (1988), among others, views science and technology as a network of actors that operate through various associations and arrangements, stressing that the disciplines work together to create these arrangements. Latour (1988) proposes an alternative idea to the traditional model of diffusion, in which the division between society and technology is meaningless. The emphasis should not be on something else, but rather on identifying and analyzing the connections between individuals or groups and how these connections come into existence, persist, and transform.

The field of social construction of technology originated to explain the process by which technology is created through the collaboration of various entities and institutions with competing interests and explores the factors that contribute to the success of technology and its development, considering technology as a product of social constructs that result from conflicting groups with differing perspectives and interpretations of identified problems, and the subsequent development of technical solutions. Herein, each device has several possible paths, and the chosen path is the result of interactions between actors from different interests, leading to stabilizations through power relations. Social constructivists believe that technology is socially constructed and shaped by social, cultural, and political factors, and that technology is not a neutral

force, but rather reflects the values and interests of those who create and use it. Social constructivists also emphasize the importance of context in understanding technology and its impact on society (cf. e.g., Winner, 1986; Latour, 1988).

Critical theorists such as Horkheimer (1976), Adorno (Adorno et al., 1950), Marcuse (1991), Habermas (1971, 1974), and Honneth (1991) argue that technology is shaped by the dominant ideology of society and that technology is used to reinforce existing power structures and to maintain social control. Marcuse (1991) analyzed advanced societies and argued that technology has become a central element of development. Habermas (1971; 1974) identified it as a project of evolution driven by success and work, believing that it is indifferent and exists in two areas, work, and communicative interactions, governed by norms organized around shared language. Habermas (1971, 1974) observed increasing state intervention in the economy, focusing on ending the dissociation between praxis and technique through technocratic awareness (Habermas, 1971: 84, 87; 1974: 121).

3.2 Theoretical Framework for the Analysis Approach

Authors including Feenberg (1996; 2002; 2005), Noble (1993; 2086), and Winner (2020, cf. Imola, 2019) have developed a critical analysis of technology and its role in society. This approach, known as the critical theory of technology (CTT), encompasses the work of these authors, with Feenberg being the main proponent of the term. This area of inquiry is an offshoot of critical theory, which investigates the effects of technology in relation to society and how it influences people's perceptions of reality. This perspective emphasizes the need to critically evaluate political, economic, and social implications of technology, rather than simply accepting its developments uncritically.

The CTT is a broad and diverse field that has evolved over several decades. The theory draws on a range of disciplines and is influenced by the works of the cited thinkers such as Ellul (1967), or Marcuse (1991), and there are various most influential books and journal articles that have contributed to this field. Heidegger's essay (1977), in which the author argues that technology has a fundamental impact on the understanding of the world can be considered a starting point for CTT. Marcuse (1991) argues that technological progress and consumer culture have created a society in which individuality and critical thought are suppressed, and that a revolution in consciousness is necessary to break free from this one-dimensional world. Debord (1970) provided a critique of the media and consumer culture, arguing that they have created a society in which appearances are more important than reality, and suggesting that the only way to resist this spectacle is to engage in radical political action. Ellul (1967) expresses a comprehensive critique of modern technology and its impact on society, arguing that technology has become an autonomous force that shapes our lives, rather than a tool under our control. Borgmann (1984) explores the relationship between technology and human experience, suggesting that technology can either enhance or detract from our ability to engage with the world in a meaningful way.

Feenberg (2005) provides a comprehensive overview of the CTT and its major themes, arguing that technology is not neutral, but rather embodies social and political values. Postman (1993) examines the cultural implications of technology and argues that our society has become dominated by technology, further arguing that people need to reclaim humanity and rediscover the importance of values that cannot be measured by technology. Kurzweil (1999) presents a vision of the future in which technology will lead to a new era of spirituality and transcendence, stating that mankind is on the verge of a technological singularity that will fundamentally transform human consciousness, while Srnicek/Williams (2015) present a vision of a post capitalist society in which technology is used to liberate rather than exploit worker, and emphasize a need to embrace automation and use technology to create a society that is more just and equitable. Pater (2016), instead, explores the political and social implications of design and the ways in which designers can shape the understanding of the world, as it can either reinforce or challenge existing power structures.

By considering these references, the approach of this theory typically involves identifying the ways in which technology shapes the world, examining economic and political forces that drive technological development and determine its direction, analyzing the impacts of technology, including its effects on relations and cultural norms, evaluating the ethical implications of technology, including questions of justice and autonomy, and also developing alternative visions for technology. In essence, it seeks to provide a comprehensive and critical analysis of the role that technology plays in shaping people's lives and the world, and to promote more responsible use of technology. In this approach, technology is seen as a political and contested phenomenon, subject to normative criticism and the possibility of alternative projects. Technology is viewed as a product of multiple economic and social factors in dispute processes, including the modern technological stage (Feenberg, 1996: 16). Technology is recognized as a political construct subject to fundamental reconfiguration based on changes in the relative power of the parties involved in its design (Noble, 1986: IX).

Feenberg (2005: 52) employs the concept of a technical code to establish a connection between technical and social demand and as a space of conflicting interests (2005: 54). In a more recent work, the author (2017: 3-12) distinguishes technical codes from specific components and technical domains - interests translated into guidelines linked to technological advancement. For Feenberg (2005), the presence of social values alone does not fully explain technology and offers a dual-level theory (cf. Susen, 2020, 734-782). The first level deals with the relationship between society's functionality and reality, which involves decontextualizing objects to identify their most immediate use. The second level pertains to the object's design and implementation within the technological set, revealing interests, contradictions, reactions, and conflicts. According to Winner (2020), an artifact is a piece or systems of hardware (2020: 22), made up of components a unit of analysis, which might be e.g., an application, or which can also be a software, or as well another type of feature. Winner (2020) argues that

technical objects contain politics, while Noble (1986) and Feenberg (1999; 2002) emphasize their role in power struggles. As innovations, they are produced for commercialization and profit-making in the market. The merchandise competes with other similar and distinct products, can be combined with other components to form e.g., a digital platform, and its designer gains ROI from their sale.

The way technology evolves is influenced by the cultural context in which it is utilized, resulting in unique patterns of development. Thus, technology is a component of a societal project, creating a dialectical relationship between product and driving force. Feenberg (1996; 2002: 3) suggests a new direction for technology that would result in a radical reorientation of values, advocating for a technology reform approach that considers the political and cultural values underlying technical arrangements, an approach complemented in later works (Feenberg, 2005). To evaluate the success of a technology, it is necessary to consider interests rather than just efficiency, and to recognize the role of hegemonic groups and dominant ideology in selecting among available alternatives. Feenberg proposes that considering interests, not just those of dominant groups, is crucial for measuring alternative success, and changing the design of technology is necessary to address these concerns. He suggests a democratic transformation from below could substantially alter the technical area.

According to the CTT, technological development is not a linear process driven by efficiency or independent of society. The idea of progress is often used to justify relationships of domination and promote specific interests, disguising them as technical justifications. Winner (2020) highlights this optimistic view of technology's potential benefits. The development of technology has been tied to economic growth, and concepts such as economic prosperity, modernity, and development have been used to promote it. However, this emphasis on economic efficiency often obscures the broader implications of progress. The authors of CTT critique the ideology of technical progress by emphasizing that the recognition of evolution is based on the configuration of different interests, whereby technological development is seen as a dynamic process where certain sides work together to influence flows in a specific structure. This environment is known as the field of technological possibilities, where definitions, and negotiations are taking place. These occur through planned actions and conducts that aim to reduce the complexity of the environment and provide stability for praxis. The production of new technologies takes place in a structure, where selectors also act to influence it to achieve their desired technological outcomes (cf. Feenberg, 2002; Winner, 2020). As such, the process of technological development can be a site of conflicts.

3.3 Analysis Approach Applied in the Investigation

The systematic approach to understanding and mapping the impact of technology on the digital platform economy involved several key steps, the first one being a thorough review of the relevant literature on the topic, including academic studies, industry reports, and government publications, to provide a solid foundation for understanding

the key issues and trends in the digital platform economy, along with factors that are driving change in this space. To gain insights into the intricacies of the digital platform economy, data was collected from various sources, such as industry associations, market research enterprises, and agencies. This information covers different aspects of platforms, including their size, scope, services, and user demographics. By analyzing these data points, it is possible to identify trends and patterns that pertain and that are inherent within the digital platform economy. To delve deeper into the different challenges and the various opportunities facing this economy, a thorough examination of the legal frameworks that govern digital platforms was conducted. Additionally, economic as well as, to an extent, social factors influencing their growth and impact were also studied. The CTT theoretical approach was applied to critically review and analyze the role of technology and its components, and to understand the complex interplay between technology, markets, and society in this changing and dynamic environment.

From a CTT perspective, technology is not neutral, but rather shaped by social and economic forces, and is used to reinforce existing power relations. The approach of CTT aims to examine economic as well as societal implications of technological advancements, along with their effects of technical features on users. When applied to the digital platform economy, CTT can offer distinct perspectives on how technical features like algorithms, data collection and exploitation, and network effects operate and influence outcomes, which then contribute to the consolidation of power among dominant platform companies. CTT can also help to identify how these technical features may perpetuate existing inequalities and exacerbate disparities. The analysis using CTT may also concentrate on how technological advancements affect the gig economy and the forthcoming work trends. By doing so, CTT can contribute to a more nuanced understanding of the challenges and opportunities presented by technology in the 21st century. As such, the CTT offers a set of references that form a theoretical framework for analysis, which involves several key steps that can be synthesized and grouped into the two main review approaches of this study:

1) Determine the technology under examination and its intended function, along with the wider economic, political, and social setting in which it is utilized. Analyze the technical features of the technology, such as its design, functionality, and user interface, and how these features shape the user experience and interaction with the technology. Identify the stakeholders that are involved in the development and deployment of the technology, including developers, users, and other affected parties. This step of the analysis is performed throughout chapter 4 (Technical Components of Digital Platforms) of the study.

2) Examine the power dynamics at play within the technology ecosystem, including issues related to ownership, control, and access to data. Evaluate the potential economic, political, and social impacts of the technology, including its effects on power structures, employment, and inequality, and identify the stakeholders in-

volved, such as regulators or privacy advocates. Consider alternative technological designs or approaches that could mitigate potential negative impacts and promote more equitable outcomes. These steps of the analysis are performed throughout chapter 5 (Technological Impact on the Digital Platform Economy) of the study.

Chapter 4 (Technical Components of Digital Platforms) focuses on components and their development in standardizing solutions for certain demands. These elements include the available technology, its structure, composition, functionalities, financing models, performance in competing markets, as well as their consumption. The framework is applied to investigate technical components within the particular focus on the setup of digital platforms and will explore demands and pressures that shaped technologies such as protocols and standards, network infrastructure and connectivity, CPUs, mobile devices, applications and application programming interfaces, data collection, blockchain, algorithms, artificial intelligence (AI) and machine learning (ML), augmented and virtual reality (AR/VR) and related developments towards a metaverse. The technical elements that form the basis of these platforms, including their structure and layout, must be investigated to understand how they are created, implemented, and sustained, and how they are utilized by various actors within the platform system. In addition, it is also critical and important to analyze how these technical components contribute to the distribution of power within the platform ecosystem, and how they affect different stakeholders, such as platform users, workers, and investors.

Chapter 5 (Technological Impact on the Digital Platform Economy) focuses on the influence of economic, political, and cultural factors in the digital platform economy. These factors include market structures, consumer demand, product availability, economic cycles, competition, government regulations and policies, and political forces. The chapter also focuses on how the analysis of technology must not only consider the application or system, but also its circulation in real life, its competition with other applications, and the ways it is perceived and used by consumers and other stakeholders. This concrete application of technology plays a fundamental role in its existence and affects other areas, as it is also a factor of change. As such, in chapter 5, a deeper understanding of the competitive field in which digital platforms operate is needed. The chapter offers a broad introduction to the digital platform economy and its associated markets, before delving into specific features and effects, including multi-sided markets, network effects, pricing mechanisms and value exchange, scaling and scalability, data collection and exploitation, ecosystems, and concentration. Indicators are employed to evaluate services and platforms within the economy, aiding in the analysis of their business models, revenue streams, competitive positioning, and employed strategies. In addition, legislation, regulatory intervention, platforms' terms of service, and the future of work are reviewed. To comprehend the effects of the platform on its regulatory review and compliance with legal rules and regulations, it is crucial to investigate the platform's user base and the varying viewpoints held by different audiences.

To investigate these economic relationships, the study involves analyzing source documents like annual reports, terms, letters, publications, interviews, financial data, and news. Case studies have become an essential tool for illustrating the impact of technology on the digital platform economy. This study utilizes the case study method for a comprehensive investigation of real-life contexts. The investigation employs multiple sources of evidence (Yin, 2003: 14), including documentation, records in archives, direct observation, and physical items, except for interviews, which were replaced by a more conclusive and less biased a literature review. According to Yin (2003), case studies are empirical investigations of contemporary phenomena within their context. Case studies allow researchers to conduct in-depth analyses of the interactions between technology and various economic, political, and social factors, as well as their impacts on different actors within the platform ecosystem.

Case studies provide a rich source of information that allows to draw nuanced and contextualized conclusions (cf. Eisenhardt, 1989: 532-550; Parkhe, 1993: 227-268) about the effects of technology on various aspects of the platform economy, helping to understand how technology impacts various dimensions of the platform economy, including innovation, disruption, competition, and related user behavior. Furthermore, case studies can provide insights into the interactions between technology and different actors within the platform ecosystem, such as users, platform providers, and regulators. For example, case studies of social media platforms can reveal how algorithmic content curation shapes user behavior, as well as how content moderation policies affect free speech and political discourse. These case studies can inform debates about the regulation of social media platforms, the role of platforms in shaping public opinion, and the potential for algorithmic bias (cf. Kordzadeh/Ghasemaghaei, 2021: 1-22; Aysolmaz et al., 2020; Baer, 2019) and discrimination.

4 TECHNICAL COMPONENTS OF DIGITAL PLATFORMS

4.1 Overview of the Development of Hardware and Software Infrastructure

The history and development of hardware and software infrastructure have played a crucial role in shaping the digital platform economy (cf. Grad, 2022: 131-132). The early days of computing saw mainframe computers that were large, expensive, and could only be operated by trained personnel. With the advent of micro-processors in the 1970s, computing became more accessible, and personal computers (PCs) were established, which in the 1980s and 1990s became more powerful and affordable, leading to the proliferation of the web and the birth of the platform economy (Betker et al., 2002: 11-32). The development of software infrastructure in relation to the platform economy can be traced to this emergence of computers in the mid-twentieth century. Initially, computer hardware and software were developed as separate entities.

With the development of operating systems and other software components, software infrastructure began to emerge as an integral part of computing systems. The first major software infrastructure development was the development of operating systems, such as UNIX (cf. Loukides, 2002), which allowed multiple users to access a computer system simultaneously, enabling the development of early computer networks, which were used primarily for scientific research and military purposes. As PCs began to gain popularity, the development of software applications for individual users took shape, leading to the emergence of the software industry, which began to develop a range of software applications for personal and business use, driven by the development of programming languages, such as C, Java, and Python (Brihadiswaran, 2021), allowing developers to create complex software applications easily.

In the 1990s, developments towards the creation and subsequent evolvement of the World Wide Web (CERN, n.d.) and the emergence of the internet as a global network changed the landscape of software infrastructure. This, in turn, led to the enhanced R&D in relation to broadband networks (Wong et al., 2009), which were able to provide faster download and upload speeds than traditional dial-up connections. The first online marketplaces, such as eBay and Amazon, emerged, allowing individuals and small businesses to sell products and services on a global scale (Galloway, 2017: 13-62). Web browsers, such as Netscape Navigator and Internet Explorer (cf. Ratha, n.d.), were instrumental in enabling users to access information and applications on the internet, while the development of web servers facilitated the creation of websites and applications.

The advent of mobile devices, such as e.g., smartphones and tablets, further revolutionized the digital platform economy. The IBM Simon was the first smartphone (Heise Online, 2014), introduced in 1993, but it wasn't until the release of the iPhone in 2007 that smartphones became widely popular and accessible to the masses (Computerworld, 2021). Considering this cited increasing use of smartphones, mobile applications (apps) have become an essential part of the digital platform economy. In addition to mobile devices, the development of networks has been a critical factor in terms

of its growth. The first broadband networks were introduced in the late 1990s, and since then, they have become faster and more reliable, allowing for the delivery of high-quality content (cf. Wong et al., 2009). As of 2019, around 60% of the global population was connected to the Internet (Kemp, 2020). This trend indicates potential for further expansion, considering an estimated 5.19b mobile phones in use worldwide.

The emergence of social media platforms like e.g., Facebook and Twitter during the early 2000s signaled a new era in the advancement of the platform economy. These platforms were built on top of the Internet, but they also leveraged user-generated content (UGC) to create value for their users. By providing a platform for users to connect and share information, these platforms were able to build audiences and create new opportunities for advertising and e-commerce. The emergence of cloud-based computing and SaaS (cf. Microsoft, n.d.) further transformed the software infrastructure landscape. Cloud computing allowed for the delivery of computing services (storage, processing power), as well as to access resources and applications over the internet, rather than relying on local hardware and software infrastructure. With that, businesses could scale their computing resources more easily as it reduced the need for significant upfront investments in hardware and software infrastructure. This has enabled companies to scale up their operations quickly and efficiently, without having to invest in expensive hardware infrastructure. Today, software infrastructure continues to evolve rapidly, driven by advances in AI/ML, and other emerging technologies. The emergence of big data and the IoT (cf. TechTarget, n.d.) has also increased the demand for software infrastructure that can handle large volumes of data, with billions of devices now connected to the web and new technologies being developed to manage and analyze it. The IoT has gained wide adoption among major players. For example, Alphabet has embraced the use of Android as OS for IoT devices, which is viewed as one of the technologies that will drive further transformation in the coming years.

4.2 Mapping Relevant Components of Digital Platforms

Mapping the relevant components of digital platforms is a crucial aspect of understanding the structure and functioning of these and typically involves identifying the key technical components of the platform, their relationships to one another, and their role in facilitating platform activities. One approach is to consider the platform as a multi-sided system, comprising a core platform and a set of complementary components, such as applications and services, identifying the technical architecture of the platform, such as its hardware and software infrastructure, and the various protocols and standards that facilitate interoperability between different components. Additionally, the mapping process should involve examining the data flows within the platform, such as the flow of user data between different components of the platform, and the rules and policies governing this flow. Another important aspect is to consider the platform's Application Programming Interfaces (APIs), which allow third-party developers to build applications and services that integrate with the platform. APIs are essential to

the platform's openness and ability to foster innovation and disruption, as they allow developers to access and use the platform's data and functionality. To understand digital platforms, it is important to consider these fundamental technical solutions that enable their creation and operation. The technical solutions identified as key components include protocols and standards, networks, CPUs, mobile devices, applications and API interfaces, data collection, blockchain technology, algorithms, artificial intelligence, and machine learning, as well as augmented reality and virtual reality:

1) Protocols and standards (refer to chapter 4.3) are critical for enabling interoperability between different systems and devices, ensuring that different components of a platform can communicate effectively and efficiently, and enable the creation of ecosystems of complementary services.

2) Networks (refer to chapter 4.4) provide the high-speed connectivity required for digital platforms to operate effectively, enabling data to be transmitted quickly and reliably, which is essential for the real-time interactions and data exchange. The internet is based on this technology, forms the global network of interconnected computer networks, enables the transfer of data and communication between different devices and systems through cloud computing, and forms the backbone of platforms.

3) CPUs (central processing units, refer to chapter 4.5) are the primary computing component of most digital devices (computers, smartphones, tablets), they are responsible for executing instructions and performing calculations, and their performance directly affects speed and efficiency.

4) Mobile devices have become a crucial component of digital platforms as they allow users to conveniently access these platforms from anywhere and at any time. As it is discussed in chapter 4.6, the widespread use of mobile devices has enabled greater flexibility for users to engage with the products / services offered by these platforms.

5) Applications (or apps, refer to chapter 4.7), are software programs that run on mobile devices or computers and allow the users to access and interact with platforms. They are often developed specifically for a particular platform or operating system and can range from simple tools to complex systems. API interfaces play a crucial role in enabling software systems to interact and exchange information with each other, facilitating the integration of products /services across multiple platforms. They are essential for creating ecosystems of complementary services / products.

6) Data collection, as discussed throughout chapter 4.8 of the study, is an integral part of digital platforms, with platforms collecting vast amounts of data on user

behavior, preferences, and demographics, data that is being used e.g., to facilitate the UX and inform targeted advertising.

7) Blockchain technology, discussed in chapter 4.9, allows for secure, transparent, and decentralized record-keeping. This can lead to a substantial reduction in the need for intermediaries and facilitate peer-to-peer collaboration and exchange. It has potential applications in finance, supply chain management, healthcare, and other industries.

8) Algorithms, as it is described and elaborated within chapter 4.10, are a series of rules or instructions that are utilized to perform tasks or solve issues. These play a fundamental part in the functioning of digital platforms, as they analyze data, power search engines, and suggest content.

9) AI/ML (refer to chapter 4.11) are used in combination with algorithms in digital platforms to analyze extensive datasets, predict outcomes, and customize the UX. They are also used to automate many of the tasks and interactions that are characteristic of digital platforms. AI/ML are growing areas of technology that have implications since they automate tasks like customer service and personalize content and recommendations.

10) In chapter 4.12, AR/VR technologies are discussed as potential game-changers for digital platforms. AR involves superimposing digital information onto the physical world, creating a mixed reality (MR) experience. On the other hand, however, VR offers new forms of user interaction and engagement, creating immersive experiences that can be used to enhance the overall experience of involved users. The so called metaverse, AR, and VR collectively are emerging technologies that are increasingly being made use of in the digital platform economy. These innovative technologies can revolutionize the UX by providing immersive and interactive encounters that merge boundaries between physical and digital realms.

In combination, these technical solutions play a pivotal role in the seamless creation and efficient operation of digital platforms. By harnessing the power of these solutions, various transformative capabilities are unlocked, revolutionizing the way data is exchanged, interactions occur in real-time, experiences are personalized, and ecosystems are formed. A profound grasp of these technical solutions becomes instrumental in identifying novel avenues for innovation, disruption, competition, and entrepreneurial endeavors within this rapidly evolving landscape. The influence of these cutting-edge technologies on operation and subsequent implications of technology within the digital platform realm cannot be overstated. A deep dive into these technical solutions unravels the intricate mechanisms behind the seamless functioning of digital platforms, shedding light on the mechanisms that drive their success and the impact they have on various stakeholders. By exploring these technical solutions, one gains insights into

the interplay between technology, digital platforms, and the economy. This knowledge enables to grasp the profound ways in which these solutions shape user experiences, drive economic growth, and transform industries. Furthermore, it empowers to identify the potential challenges and obstacles that lie ahead and paves the way for strategic decision-making, future-proofing businesses, and unlocking new possibilities.

4.3 Protocols, Standards, Their Functionalities, and Interoperability

Protocols and standards are fundamental building blocks of the Internet and, as such, of the digital platform economy (OECD, 2021). The internet is comprised of numerous interconnected networks, each operated by a distinct entity, and joined through networking hardware such as routers and switches that facilitate the transmission of data (Cloudflare, n.d.). Protocols refer to a collection of procedures and regulations that dictate communication between computers, whereas standards consist of technical specifications and recommendations that guarantee compatibility and interoperability between various devices and systems (Diallo et al. 2011: 84-91; Hodapp/Hanelt, 2022; Kerber/Schweitzer, 2017: 39-54; National Institute of Standards and Technology, n.d.). Their development initiated within the very early days of the internet, when first network protocols, e.g., Transmission Control Protocol (TCP) and Internet Protocol (IP) were developed with a goal to facilitate the communication between PCs operating on different networks (Scos.Training, n.d.; Gangane/Kakade, 2015: 3194-3201). TCP/IP specifies how data is transmitted and routed between devices over the internet and allows data to be broken into packets, transmitted across the network, and reassembled at the destination, ensuring reliable delivery of information (Gangane/Kakade, 2015: 3194-3201).

Over time, new protocols and standards were developed to address specific needs and challenges of the digital platform economy. For example, the Hypertext Transfer Protocol (HTTP, cf. Mozilla, n.d.) facilitated the transfer of hypertext documents, which served as the building blocks for the World Wide Web. This breakthrough has been instrumental in the expansion of e-commerce, online social networking, and other digital services. The Domain Name System (DNS) allows users to access websites and other resources using human-readable domain names, rather than numerical IP addresses. Whenever a user enters the name of a domain into their web browser, the DNS system translates that name into a numerical IP address that can then be utilized to locate the requested resource (Cloudflare, n.d.). Other important protocols and standards include the Simple Mail Transfer Protocol (SMTP) for email communication (Spiceworks, 2023), Universal Plug and Play (UPnP) protocol for device discovery and control (UpGuard, 2023), the OAuth protocol (OAuth 2.0, n.d.) for authentication and authorization in web applications, and the Secure Sockets Layer (SSL) (ComputerWeekly, n.d.) and its successor, Transport Layer Security (TLS), for secure communication over the internet. Standards such as the Extensible Markup Language (XML, cf. MDN Web Docs, n.d.) and JavaScript Object Notation (JSON) (w3schools.com, n.d.)

have also played a critical role, the former being a markup language that enables exchange of structured data between different systems, the latter is a lightweight data-interchange format used for transmitting data between a server and a web application.

Standards, on the other hand, are technical specifications that define how devices and systems should be designed and operated (Stack Overflow Blog, 2020) to ensure compatibility and interoperability (Kerber/Schweitzer, 2017: 39-54; Diallo et al. 2011: 84-91; Hodapp/Hanelt, 2022). A good example of a standard is the USB, which defines the physical configuration and communication protocol for connecting peripheral devices to computers (Techopedia, 2020)., while the IEEE 802.11 standard defines the specifications for wireless local area networks (WLANs) (IEEE Wireless Standards, n.d.). Over the past years, the creation of new protocols and standards has been influenced by the emergence of novel technologies and trends. For instance, the growth of mobile devices and the IoT (TechTarget, n.d.) has spurred the development of new protocols like MQTT (cf. MQTT, n.d.), which facilitates communication between and among IoT devices. Likewise, the growing significance of data privacy and security has led to the subsequent creation of new standards such as GDPR (GDPR.eu, n.d.) for protecting personal data. In the digital platform economy, protocols and standards are essential as they create a shared language and guidelines for communication among devices, systems, and applications, which promote interoperability and facilitate the exchange of information as well as respective data between various components. The development and adoption of these protocols and standards have enabled the growth of new digital services and transformed the way people interact with technology.

The mentioned term interoperability (EDPS, 2023; Kerber/Schweitzer, 2017: 39-54) means the ability of different systems or components to work together seamlessly, allowing them to exchange information and perform tasks effectively. In the digital platform economy, it is crucial to have interoperability among different platforms and services (Diallo et al. 2011: 84-91; Hodapp/Hanelt, 2022). This enables users to have more options, flexibility, and power over their data and interactions. Open standards, protocols, and APIs are key tools to achieve interoperability among them that allow different systems to communicate and exchange data in a standardized and consistent way. The adoption of these standards guarantees seamless interaction among different platforms, providing users with the ability to transfer their applications and data across various services without running into compatibility challenges.

Interoperability is of utmost importance in the digital platform economy, as different platforms and services often operate in isolation, causing users to face difficulties in switching between platforms or sharing their data across different services (cf. Diallo et al. 2011: 84-91; Hodapp/Hanelt, 2022; Kerber/Schweitzer, 2017: 39-54). Meta's integration between Messenger, WhatsApp, and Instagram (cf. Kumar, 2019: 321-327) displays the potential for interoperability between different applications within large digital platforms. A lack of interoperability can create barriers to entry, reduce competition, and limit innovation, ultimately leading to reduced consumer welfare. However, interop-

erability can also present challenges, particularly for platforms that have invested heavily in proprietary technologies (Jin et al., 2013) or closed ecosystems. By opening their platforms to third-party developers or integrating with other platforms, digital platforms may be exposing themselves to increased competition and potentially diluting their market power.

From the perspective of CTT, protocols and standards can be viewed as key technical components in the digital platform economy that have significant social and political implications. Protocols and standards are not neutral technical specifications, but rather reflect the interests and power dynamics of the actors who design and shape them. Their development is often driven by dominant actors who seek to institutionalize power and interests in the technical infrastructure, which can result in exclusionary practices, where certain groups or interests are left out or marginalized in the design and implementation of protocols and standards. CTT emphasizes a significance of comprehending the political and societal influences that occur by adopting and utilizing technological functionalities, e.g., negative effects on competition, innovation, and the protection of user privacy and rights. At the same time, the development of open and inclusive protocols and standards can promote decentralized and democratic control of digital infrastructure and support the diversity of actors and interests. In practice, protocols and standards are used to define rules and procedures for communication and interaction between digital systems and applications and are developed by standards bodies or consortia, which are then adopted by industry groups or governments as mandatory or recommended specifications.

4.4 Network Infrastructure Types, Connectivity and Cloud Computing for Information Transmission

Initially, broadband networks, understood as a physical medium over which information can be transmitted, were built by telecommunications companies such as AT&T and Verizon (Galloway, 2017: 228-229), which invested in upgrading infrastructure, however, the emergence of new players such as Google Fiber (LightReading, 2021) and municipal broadband networks (Houngbonon et al., 2021) has led to increased competition in the broadband market. The development of broadband networks, defined as networks with a minimum capacity of 256kbps speed in either the data received or sent (cf. Davies, 2016), has enabled the growth of digital platforms which rely on high-speed connectivity to deliver their services to users (Wong et al., 2009). These platforms have also helped to drive demand for broadband, as users increasingly rely on them for streaming video, social networking, and online shopping, so they have become essential to the economy, also facilitating interactions such as credit card payments or stock trade.

As such, broadband networks are high-speed telecommunications networks that allow users to access a wider range of digital services and content, including the inter-

net (Wong et al., 2009). The Internet in its capacity as a global network of interconnected computer networks (Cloudflare, n.d.) which facilitates the transfer and sharing of data and information and creates a distributed system that enables the communication between different computers and other, additional devices using a uniform set which is comprised of regulations and procedures. Hereby, speed is important for various reasons, including in relation to access, to continuity of the connection, and to the ability to enjoy multiple services simultaneously. The speed impacts the user experience (Wong et al., 2009), with slower speeds loading websites and content with delay. Networks are based on various technologies and infrastructures, such as fiber optic cables, coaxial cables, and wireless networks (C Valley Network Solutions, n.d.).

Broadband technology has seen recent developments with the expansion of fiber optic networks, which provide faster and more reliable internet connections than traditional copper-based broadband services. The predominant infrastructure employed in broadband networks are fiber optic cables, which are composed of slender strands of glass or plastic that transport digital signals through light waves. Fiber optic cables have extremely high bandwidth, allowing them to transmit large amounts of data over long distances with very little signal degradation (C Valley Network Solutions, n.d.). Some of the most prominent fiber optic broadband networks include Verizon's FiOS, Google Fiber, and AT&T's U-Verse. Alphabet's Access division offers various internet access and infrastructure services, such as Fiber that provides high-speed internet access through optical fiber, and Web Pass which aims to connect a user to the web via satellites. The former currently serves 45 cities in the US (BroadbandNow, 2020), while the latter covers 11 more (Google Fiber, 2020). The Google Fiber service offers internet speeds of up to 1k Mbps and provides a simple online experience without requiring modems, contracts, or additional fees.

Coaxial cables (e.g., Comcast Xfinity and Charter Spectrum) are another type of infrastructure used for networks, particularly for cable internet, consisting of a copper wire surrounded by insulation, which is then wrapped in a second layer of wire mesh and covered in a protective coating. Coaxial cables have a lower bandwidth compared to fiber optic cables, but they can still provide high-speed internet access (C Valley Network Solutions, n.d.). Wireless broadband networks use radio waves to transmit data over the air (Wong et al., 2009) and are particularly useful for providing internet access in remote or hard-to-reach areas. There are several types of wireless broadband networks, including cellular networks, satellite networks, and Wi-Fi networks (Wong et al., 2009). The growing availability of 5G mobile networks is a trend in this regard, offering high-speed broadband services to mobile devices and supporting the infrastructure for the IoT (TechTarget, n.d.). Examples include Verizon Wireless, T-Mobile, and AT&T Mobility for cellular networks, and HughesNet and Viasat for satellite networks (Wong et al., 2009). This ecosystem of network infrastructure is completed by servers that store information accessed on sites and other apps.

By providing high-speed internet access and by enabling users to connect to online services and platforms more easily and quickly, networks facilitated the development

of various digital platforms that have disrupted traditional industries and business models. For instance, platforms like Netflix, YouTube, and Spotify have leveraged broadband networks to provide video and music streaming services that have disrupted the traditional media industry (Weinman, 2015: 197-210; Green, 2023), creating new ways for users to consume media content and challenging the dominance of traditional media companies (Wong et al., 2009). Similarly, the likes of Amazon and Alibaba used the technology to provide online marketplaces, enabling consumers to purchase goods / services online, leading to the decline of brick-and-mortar stores, and, thus, disrupting the traditional retail industry (Galloway, 2017: 13-62, 206-210).

They also facilitated the growth of the sharing economy (cf. Agarwal/Steinmetz, 2019; Hamari et al., 2016: 2047-2059), with platforms like Airbnb using them to connect consumers with providers of various services, creating new ways for individuals to monetize their assets and skills. Lastly, they enabled the development of novel technologies such as AI and the IoT (TechTarget, n.d.). The digital divide, or the disparity between individuals who have access to broadband and those who do not (Digital Divide Council, n.d.), has become a more significant concern in recent years. This issue can have implications for both the economy and society, as it restricts access to information and services that are increasingly provided online. Governments and other organizations have therefore sought to expand broadband access through initiatives such as the Federal Communications Commission's Connect America Fund and the European Union's Digital Agenda (cf. European Council on Foreign Relations, 2020).

Today, cloud computing is an indispensable technical solution in relation to infrastructure (cf. Khan/Alam, 2017; Birje et al. 2017), and a primary solution for providing instant access to shared computing resources, including storage, processing power, and network connectivity. The technology has been transformative for businesses, allowing to reduce infrastructure costs, scale operations, and deliver more agile and responsive services to their customers. Its model offers several benefits over traditional on-premise computing, such as increased flexibility, scalability, and reliability and permits companies to pay for the resources they use, rather than investing in expensive hardware or software infrastructure. It also offers on-demand access to computing resources, enabling businesses to respond quickly to changing market conditions and to customer demands. The cloud market is dominated by few key players, which have constructed vast data centers and infrastructure to support the model, and offer a broad range of services, including infrastructure-as-a-service (IaaS, cf. Shahzadi et al., 2017), platform-as-a-service (PaaS, cf. Yasrab, 2018), and software-as-a-service (SaaS, cf. Al-Madhagy et al., 2021: 213-253). Some of the most significant examples of cloud computing in the digital platform space include cloud-based storage solutions like Dropbox and Google Drive, collaboration tools like Slack and Microsoft Teams, and streaming services like Netflix and Spotify. Additionally, cloud computing has enabled the development of innovative new technologies, such as AI/ML, which are used in various apps, from autonomous vehicles to voice assistants.

From a CTT perspective, the discussed technologies can be viewed as a central infrastructure that shapes the way in which the economy operates, as it embodies political and economic interests by being controlled by large corporations and governments, which can use them to further their own agendas. The way in which digital technologies are rolled out and overseen can have notable effects on various matters, including access to information, social disparities (Keese, 2016: 76-88), and democratic involvement (cf. Social Development Division, 2021: 24). These are all considerable factors that must be taken into accounts when it comes to creating and enforcing relevant policies. As such, e.g., a focus on profit and market-driven competition can result in unequal access to high-quality broadband services or cloud computing, as corporations may choose to invest in high-income areas rather than low-income areas.

Further, a small number of dominant players gained power and influence over the digital platform economy, also through their ownership and control of cloud infrastructure. These companies have constructed vast data centers and control most of the cloud computing market, which allows to dictate terms and conditions under which other businesses can access and use computing resources. Also, individuals' data is collected and monetized in the cloud without obtaining knowledge or consent, leading to concerns about privacy, data ownership, and the exploitation of user data for commercial gain. The development and deployment of networks are the result of specific historical and political processes, influenced by economic and political interests, and, as such, can reinforce power structures.

4.5 CPUs Performing Arithmetical and Logical Input / Output Operations

The origin of processors dates to the 1950s with the creation of transistors, which facilitated the development of smaller and more powerful computers. This development led to the subsequent emergence of microprocessors in the 1970s (Computer Hope, 2022). These early microprocessors were used for PCs which became widely popular in the years of the 1980s and 1990s. In the 2000s, processors became even more powerful with the development of multi-core technology (Gepner/ Kowalik, 2006: 9-13), which allowed for multiple processors to be integrated into one single chip. This helped for PCs and other devices being able to deal with more complex tasks, which consequently lead to the emergence of novel technologies (e.g., cloud computing, data analytics, or AI/ML). The rise of mobile devices (cf. Rouge Media, n.d.) in the 2010s also had a significant impact on processor development, as the demand for smaller and more energy-efficient chips grew, leading to the development of System on a Chip (SoC) technology (ESA, n.d.)., which integrated multiple components such as the processor, memory, and graphics into a single chip. Presently, the development of processors persists with the arrival of cutting-edge technologies like quantum computing, which are anticipated to offer superior processing speed.

Processors, also known as central processing units (CPUs), are electronic devices that execute computer programs by performing arithmetic, logic, and input/output operations, and constitute the main component of computers and digital devices (Encyclopedia Britannica, 2022). They work by fetching instructions and data from memory, processing them, and storing the results back in memory and consist of various functional units, including arithmetic logic units (ALUs) (Zhang et al., 2012: 1969-1973), control units, and caches, which work together to execute instructions. Processors can have multiple cores, which allow them to perform multiple tasks simultaneously. While Intel had been the leader in the market, AMD closed the gap in 2006 before it widened again until 2016 (Rexaline, 2019), while ARM follows suit. Intel and AMD are known for their x86 processors, which are used in PCs, servers, and other digital devices. In contrast, ARM is a company that focuses on designing processors with low power consumption, typically found in mobile devices (Bitmovin, 2022).

In recent times, there has been an observable trend towards using specialized processors, like tensor processing units (TPUs) as well as graphics processing units (GPUs) (Google Cloud, n.d.a), which are designed to perform specific tasks, such as image and video processing, ML, and AI. Google, Microsoft, and Amazon have built their own custom processors (Bloomberg, 2021) specifically optimized for AI and ML workloads. The development of dedicated AI accelerator chips has become necessary to perform tasks such as image recognition and NLP (IBM, n.d.c) more efficiently. Another of the developments is the release of new processors that use advanced manufacturing processes, yielding smaller, more efficient chips that have higher performance capabilities (as observed in e.g., the gaming industry). High-performance processors, such as Intel Core and AMD Ryzen processors (Bonshor, 2023), have enabled the development of more sophisticated and immersive gaming experiences, driving demand for increasingly powerful and efficient hardware. In the mobile industry, processors have enabled the development of smartphones with increasingly advanced capabilities. The introduction of processors such as the Qualcomm Snapdragon (DPR Staff, 2021) and Apple A-series chips has enabled features such as facial recognition, AR, and advanced camera capabilities (Adjabi et al., 2020). Powerful and energy-efficient processors have also been instrumental in the growth of cloud computing and data centers (e.g., Intel Xeon, AMD EPYC, cf. Bordenave/Boros, 2022), has enabled the growth of cloud services and big data analytics, driving innovation and competition in the industry.

As it has been elaborated within chapter 3.2, CTT emphasizes the importance of examining the societal implications of technological features within the digital platform economy, including queries around the entities responsible for their creation and implementation, as well as their potential effects on the society. One concern is, as demonstrated, the concentration of power among few large technology companies that dominate a market, in this case the market for processors and related technologies, leading to a lack of innovation and competition, as smaller companies may struggle to compete with the dominant players. Furthermore, these dominant players may use

their power to exert control over other industries and even governments, leading to concerns about corporate influence over political decision-making. Another concern is the environmental impact of technologies such as processors and related items. The production and disposal of electronic devices contributes to environmental degradation using non-renewable resources and the generation of electronic waste (cf. Kwazo et al., 2014: 83-88), while the energy consumption of data centers and other facilities that use processors can contribute to carbon emissions and climate change (Ahmed et al., 2021; Raizada et al., 2020: 8-15). The growing use of processors and associated technologies in automating tasks can result in job displacement, and the technology can also be utilized for worker monitoring and control, posing concerns about privacy and autonomy.

4.6 Mobile Devices, Their Functionalities, and the Enablement of Mobile First Platforms

The computer and PC industry has become a driving force of technologies, leading to new opportunities for market expansion from the 1980s onwards, after which the shift in dynamics between PCs and mobile devices took place, with PCs showing a strong growth curve in the 2000s, but declining after 2010, while smartphones experienced exponential growth thereafter (Rouge Media, n.d.; Harvard Business Review, 2013). Although PC sales declined from 2011, they stabilized over time, while the market share of PC sales shifted away from companies like IBM and Apple towards HP, Dell, Lenovo, and Apple, which together account for almost 70% of global sales (Statista, 2020a), followed by Asus and Acer. The analysis in historical perspective reveals concentration in the market, with the slice called others declining from 2011 to 2017 from 44% to 17% (Statista, 2020a). In 2005, only 27.3% of homes had a computer, but by 2019, the penetration rate had risen to 49.7%, with nearly half of the population owning a PC (Statista, 2020a). Mobile devices have had a significant impact on the advancement of the digital platform economy, allowing users to access a variety of different platforms and services while these users are on the move (Rouge Media, n.d.; BankMyCell, 2022).

In the early 2000s, the introduction of the BlackBerry (The Canadian Encyclopedia, n.d.) and other early smartphones paved the way for a new generation of mobile platforms, providing users with access to email, messaging, and other applications, and they quickly became popular among business professionals and other early adopters. The launch of the iPhone in 2007 (Computerworld, 2021) marked a major turning point as it was the first device to feature a large, high-resolution touch screen, and it introduced a new paradigm for mobile computing with its intuitive user interface and extensive app ecosystem (Rouge Media, n.d.). This ecosystem allowed developers to create new applications and services that could be accessed directly from the device. The emergence of the Android OS in 2008 facilitated the rapid expansion of the mobile

platform economy (CodeSubmit, 2021). By providing an open-source environment, developers could create new apps and services that worked on a variety of devices. Android quickly became the dominant mobile OS, now running on more than 3b devices (Cranz, 2021). The total amount of people using mobile phones, was over 4b in 2016 and 5.19b in 2019, resulting in in over 200b mobile app downloads and a spending of $120b on apps and related purchases (Kemp, 2020).

Mobile devices are electronic devices that are designed to be portable and handheld, and that can access and processing digital information and data (Rouge Media, n.d.). These devices rely on wireless communication technologies such as cellular networks, Wi-Fi, and Bluetooth to enable communication and data transfer and consist of a combination of hardware and software components. The coordination of the latter and their interface with the hardware are managed through what has been called the operating system (OS). Examples of popular mobile OS include Apple's iOS, Android, and Microsoft's Windows Mobile (Novac et al., 2017: 154-159.). When examining the OS, it is evident that the market is highly concentrated. According to Net Marketshare (2020), Android has an impressive 70.84% market share, with Apple's iOS following closely behind at 28.7%. Niu (2019) adds that Android powers over 75% of all mobile devices globally. In 2020, Androids' market share reached 38.3%, while Microsoft's was at 36.55%, dominating the mobile OS market with over 87% (Statista, 2020e). According to Kerns (2019), there are now more than 2.5b devices running on Android, made by over 180 hardware manufacturers. Not all these devices are smartphones, as they also include smart speakers, smart displays, and KaiOS phones. This domination by Android and iOS is so pronounced that the remaining players in the field, such as Series 40, Linux, RimOS, Symbian, Bada, or Windows Mobile, only constitute 0.46% in terms of share. The hardware components include a CPU, memory, storage (RAM), a display screen, and input/output components such as touchscreens, buttons, and cameras. The software components include an OS and various applications that are used to perform specific functions such as communication, entertainment, and productivity.

The technical operation of mobile devices involves a complex interplay between hardware and software components, as well as between the device and the wireless networks and other devices with which it communicates. Thus, a crucial aspect of mobile devices is their app ecosystem, composed of the diverse applications that are being created and distributed for use on these devices. According to BankMyCell (2022), there are currently over 6b smartphones in use around the world, which are utilizing apps. The application ecosystem includes both proprietary (cf. Jin et al., 2013) and open-source applications, and is supported by a range of software development tools and platforms. Mobile devices come in various forms, such as smartphones, tablets, and wearable devices like smartwatches and fitness trackers. Among these devices, smartphones have become indispensable in daily life, providing functions such as communication, entertainment, and productivity. The mobile device market is dominated

by Asian manufacturers, with Samsung being the leader with a market share of approximately 21%, followed by Apple with 14% (Statista, 2019a). Huawei, Xiaomi, and Oppo (all Chinese companies) also compete in the market with 10%, 7%, and 6.8% respectively. The market is highly competitive with others covering 40% of global sales, while main players account for 60%. The market has seen Samsung's rise since 2009, accompanied by Nokia's decline and sale of its mobile division to Microsoft in 2014 (Statista, 2019a).

The emergence of mobile-first platforms, such as Instagram and TikTok (Miltsov, 2022: 664-676), have leveraged the unique capabilities of mobile devices to create highly engaging UX, disrupting traditional media channels, and providing a means for users to create, share, and consume content on the go. Mobile devices have also transformed the e-commerce industry by developing highly sophisticated mobile apps that enable users to shop online from anywhere at any time (e.g., Alibaba, Amazon), further enabling peer-to-peer marketplaces like Etsy (Church/Oakley, 2018: 1-21) and Poshmark, where individuals can sell products directly to consumers. Organizations can first gather and subsequently interpret data on their users' activities and preferences, and improve their performance by customizing product suggestions, boosting customer service, and offering users more pertinent and interesting material. The swift expansion of AI/ML has prompted the creation of novel software and hardware that are optimized to support these technologies. In addition, VR/AR technologies have experienced significant growth and are now being utilized in a range of applications, such as gaming, education, and training. There is growing emphasis on energy efficiency and reducing the environmental impact of computing, leading to the development of sustainable technologies and materials.

As such, mobile devices as technologies are intertwined with economic, social, and political aspects and are a product of economic systems that utilize technology to further their interests. They are designed and marketed in ways that aim to maximize profit for the companies that produce them, often leading to the exploitation of workers and resources. Like with other products, the development of mobile devices is shaped by market forces, leading to the design of devices that prioritize convenience and entertainment over user privacy and control. The data generated by these devices are also exploited by the digital platform economy, enabling targeted advertising and algorithmic manipulation of users. Thus, a CTT view calls for critical examination of the development, design, and usage of technology.

4.7 Applications, Application Programming Interfaces, and Engagement

Applications, commonly known as apps, are software programs designed for mobile devices, desktop PC, and other platforms. Mobile devices have gained popularity in the digital platform economy foremost for their capability to provide users with a diverse range of services and conveniences. However, their significance grew exponentially with the emergence of mobile devices with which apps became ubiquitous

(Manifesto, n.d). The development of mobile operating systems such as iOS and Android in the late 2000s allowed developers to create and distribute apps through app stores, which simplified the process of finding and downloading apps for users. Consequently, there was a surge in the quantity and assortment of applications accessible, ranging from basic amusements and tools to intricate efficiency software and social networking sites.

As the app market grew, it also became more competitive. Companies (e.g., Apple, Google) began curating their app stores to promote popular apps and to provide a platform for developers to reach a large audience. The success of certain apps led to the rise of app stores as a means of distribution and revenue generation. Today, apps are a crucial part of the everyday life, offering a range of services from transportation and food delivery to social networking and personal finance management. The growth of ML/AI technologies has continued to fuel the development of applications to improve app functionality and personalization. The impact of applications on the digital platform economy is therefore significant, with apps playing a central role in connecting users to services and businesses. Companies that can develop successful apps can gain a competitive advantage in their market, while app stores provide a secure and steady revenue stream for both developers and platform providers.

In technical terms, programming languages like Java, Objective-C, or Swift are used to create apps, which are then compiled into executable code, as described in Clark (2021) that can be installed on the user's device. They interact with the OS and hardware of the device to provide the user with a specific service, such as gaming, social media, productivity, or entertainment. Examples of popular mobile apps include social media platforms such as TikTok (Miltsov, 2022: 664-676), Instagram, and Twitter; messaging apps such as Telegram (Nobari et al., 2017: 2035-2038) and Messenger; entertainment apps such as Netflix and YouTube; and gaming apps such as Candy Crush and Pokémon Go (Hamari et al., 2018: 804-819). On the desktop, common applications include productivity tools like Microsoft Office and Adobe Creative Suite, as well as web browsers like Bing and Mozilla Firefox. App stores, such as Apple's App Store, as well as the Google Play Store, provide a platform for developers to distribute their apps to a large audience. Users can download and install apps directly from these stores onto their devices. The app stores also provide features such as user reviews, ratings, and app recommendations to help users discover new apps that they may find useful or interesting.

In basic terms, application programming interfaces (APIs) are a collection of guidelines and programming instructions for interacting with software applications or tools that are internet-based (IBM, n.d.a). Companies such as Salesforce and eBay were among the first to offer APIs for their web-based services (Hawkins, 2020). These APIs allowed developers to build applications that integrated with these services, easing it up for their users to access and use them. As the popularity of APIs grew, other companies began to offer APIs for their services. APIs are usually accessed over the internet, and they rely on a range of network protocols and technologies to function (IBM,

n.d.a). APIs can be accessed using different programming languages, which makes them highly versatile and interoperable (cf. Kerber/Schweitzer, 2017: 39-54). Typically, accessing an API involves initiating a request to a server through a specific URL and HTTP method. Upon receiving the request, the server proceeds to process it and then sends a response in the requested data format, which may include JSON, XML, or other data formats. The client application can then parse the response and use the data to interact with other software applications (IBM, n.d.a). One of the key drivers of the growth of APIs has been the rise of mobile devices and the need for mobile applications. APIs provide a way for developers to access and use data from web-based services in their mobile applications, leading to the development of many popular mobile applications, including social media apps, transportation apps, and banking apps.

The so-called API economy (Kong, n.d.) refers to the economic value that is created by the exchange of data and services through APIs. Companies like Stripe and Twilio offer APIs that enable businesses to easily integrate payment processing and communication functionality into their software applications. This has triggered a new generation of software startups to rapidly prototype and launch new products, without needing to build complex payment or communication systems from scratch. As more companies offer APIs for their services, developers can build more innovative applications that can access and use data from multiple sources. Prominent examples of APIs include the Google Maps API, which enables developers to embed Google Maps in their applications and to customize the maps with their own content, the Twitter API that, that developers access to interact with Twitter data, including tweets, followers, and trends, or the Facebook Graph API, that allows for access and interaction with Facebook data such as user profiles, posts, and pages (van der Vlist et al., 2020). The company's login API allows users to log in to third-party applications using their Facebook credentials, which makes the login process simpler and more convenient for users and allows developers to access basic user information such as their name, email address, and profile picture. Using the Messenger API, developers can design chatbots and interactive features that can be applied in a variety of situations, including customer support, automated messaging, and other purposes. Cloud providers such as AWS, Google Cloud Platform (GCP), and Microsoft Azure offer APIs that allow developers to easily provision and manage computing resources in the cloud. Alphabet's digital portfolio is enriched with specialized companies such as Apigee (n.d.), which develops APIs and digital solutions for businesses.

KPI that are commonly tracked on an app level to measure the success of an application can be demonstrated by taking a YouTube channel as an example. Views can hereby measure the number of times a video has been viewed and are a suitable indicator of how many people are interested in the content. The total number of views a video receives can vary greatly depending on the topic, length, and quality of the video. Some videos may only get a few hundred views, while others may receive millions or even billions of views. For example, the most viewed video on YouTube, Baby Shark Dance by Pinkfong, has over 12.3b views (Statista, 2021b). Watch time

measures how much time people spend watching a video. This is an important metric because the algorithm prioritizes videos with higher watch times. Watch time can vary widely based on the length of the video and how engaging it is. Engagement measures how people interact with videos, such as through likes, comments, and shares. High engagement is a sign that content is resonating with the audience. The number of subscribers to a channel is an indication of its popularity and potential audience reach, making it a useful metric to measure. The number can vary depending on the content and promotion efforts, and while small channels may have only a few dozen subscribers, large channels can have millions. The click-through rate (CTR) measures the percentage of people who click on a video after seeing it in their search results or recommended videos. If a video has a higher CTR, it is more likely to subsequently appear in the recommended videos section, potentially increasing its exposure and popularity. Revenue measures the earnings of a creator through ads, sponsorships, and other sources, which depend on the number of views, engagement, and advertising options, such as the type of ads, ad format, and viewer location. Finally, the retention rate measures how many people watch a video from start to finish and, as such, is a sign that a video is engaging and holds people's attention.

Apps have become a crucial tool for businesses to engage with their customers, market their products, and boost their profits. Meanwhile, these digital tools have caused significant changes in society by altering how individuals communicate, how they consume information, and how they entertain themselves. Social media apps hereby have created a global community where individuals can enter interaction with each other and share their respective opinions and their personal insights. Meanwhile, educational apps as the likes of e.g., Babbel have revolutionized the learning experience for people, allowing individuals to gain knowledge and acquire novel skills in a self-paced and more convenient way.

From a CTT perspective, however, apps can be viewed as products reflecting and reinforcing the dominant power structures in society. In the context of the digital platform economy, applications have been instrumental in enabling platforms to provide value to users and capture value from them. Herein, APIs can be seen as both an enabler and a constraint. APIs have a dual role in that they empower developers to create new services and apps on top of established platforms, leading to increased innovation and variety. However, APIs can also be utilized to regulate data access and functions, which may create an asymmetry of power between platform owners and developers. Such concerns are raised by CTT regarding the development and distribution of products, as they may contribute to the concentration of power and resources in the hands of a select few dominant companies. CTT also highlights the issue of (platform) dependence, where users become locked into a specific (platform) ecosystem and resulting power increase. Additional concerns exist around the collection of user data via apps and the potential for commercial or political exploitation of that data, along with its impact on employment, particularly within the gig economy (Bulian, 2021: 106-119; Janadari/Preena, 2020: 1-14; Ostoj, 2021).

4.8 Data Capture, Storage, Processing, and its Analysis

The pursuit of data has become a vital economic factor in guiding business strategies and service provision. Data is providing the fuel that powers algorithms and ML systems that underpin many of the most successful platforms. In the very early days of the Internet, data was primarily used to improve the performance of search engines and other online services, but as the platform economy grew, data became an increasingly valuable commodity, with platforms using data to build massive audiences and create new opportunities for online revenue. These platforms relied on user-generated data to provide personalized recommendations, target advertising, and optimize their algorithms. In recent times, the expansion of the platform economy has been linked to the emergence of novel technologies that facilitate the collection, retention, and evaluation of data. The rise of big data (datasets that are too large or complex to be processed using traditional data processing tools and techniques, cf. Oracle, n.d.), cloud computing, and ML has enabled platforms to process and analyze quantities of data in real time, allowing them to deliver more personalized experiences and optimize their services more effectively. This technology has resulted in its own market, with the global big data market expected to continue to grow with a projected 12% average growth rate until year-over-year and a forecasted size of around $274b by 2023 (MarketsandMarkets, 2023).

Notwithstanding, the utilization of information in the platform economy has also elicited concerns concerning confidentiality, protection, and administration, as well as the influence and authority of influential platforms and their potential to exploit their access to user data. Digital breadcrumbs or tracks are produced through the utilization of various gadgets such as smartphones, which assemble data about individuals' inclinations and activities in the digital realm. In response, governments, and regulators worldwide have initiated actions to heighten supervision and regulation of the platform economy to guarantee that it operates fairly and openly. Some have recommended new guidelines and regulations to preserve user privacy and constrain the power of dominant platforms, while others have emphasized augmenting transparency and responsibility around data.

Data collection and analysis involve the capture, storage, and processing of vast amounts of digital data (Harvard Business School Online, 2021). Information can be gathered from various origins, which include social media websites, portable gadgets, detectors, and other electronic tools that are linked to the Internet. Data collection involves the use of various technologies and techniques to capture and store digital data in a structured and organized way (e.g., information on user behavior, preferences, location, information on the performance of digital products etc.). Dealing with the massive amount of data produced by digital platforms is one of the major hurdles in data collection. To cope with this challenge, platforms make use of various tools and technologies such as data mining and ML/AI. These tools enable platforms to identify patterns and insights in the data, and to use this information to optimize their operations

and services. Examples of prominent big data platforms and tools include Google Analytics, Hadoop, Apache Spark, and IBM Watson (cf. Benlachmi/Hasnaoui, 2021; Wróbel/Wikira, 2019: 283-287).

Industries such as healthcare, finance, and retail have been early adopters of big data, utilizing it for various purposes. For instance, Alphabet's Calico, which focuses on longevity and healthcare, utilizes big data along with digital technologies. However, big data is no longer restricted to these sectors (Marzouk, 2018) and is being embraced by other industries such as manufacturing, transportation, and governments as well. The utilization of AI/IoT (TechTarget, n.d.) are also expected to contribute to the growth of big data market in the future, by extracting insights and predictions from large data sets. Recent developments in big data include the availability of cloud-based storage and computing resources, which make it easier and more cost-effective to collect, store, and analyze large amounts of data. Additionally, there is an observable and growing emphasis on safeguarding data privacy and security, which has led to the subsequent emergence of novel technologies as well as protocols for safeguarding sensitive information. Those in possession of databases can extract data, conduct analyses, and deliver forecasts or patterns. Consequently, the digital platform economy has been greatly impacted by data, as data analytics tools allowed businesses to collect, analyze, and interpret amounts of data generated by user interactions, enabling companies to gain insights into user behavior, preferences, and needs, helping to develop effective business strategies, improve operations, and enhance the UX.

By analyzing user data, businesses are able to personalize product recommendations, advertising, and content to better meet the needs and preferences of individual users, with impacts on classic digital platform KPI’s such as user engagement, retention, and loyalty, translating into increased revenues for businesses as data enabled businesses to optimize operations and improve efficiency, e.g. by using data analytics tools to develop more effective pricing strategies, streamline supply chain management, and identify potential bottlenecks and inefficiencies in platform operations, overall helping to reduce costs and increase profitability, while allowing businesses to offer more competitive pricing to users. Data plays a crucial role in enabling sharing to operate by connecting users with assets and services. This has led to the emergence of novel business models within the digital platform economy. For example, Alphabet’s Verily focuses on data analysis and solutions for the healthcare industry, combining big data, micro sensors, and treatments to develop innovative projects in the field (Nair, 2021). One of the aims of Verily is to improve Continuous Glucose Monitoring inserted in stickers for continuous non-intrusive monitoring, which collect and transmit data by wireless technology. User-generated data is a crucial component for facilitating transactions and ensuring the quality of services / goods provided on peer-to-peer marketplaces like e.g., Uber (cf. Dudley et al., 2017; Galloway, 2017: 214-220).

This use of data has also raised reflections about privacy, security, and the concentration of market power. The concentration of data can limit competition and inno-

vation, reducing the benefits to consumers as well as connected increase in the potential for data breaches and misuse of user data, which can harm consumers and erode trust in digital platforms. Additionally, the collection of data within the digital platform economy raises concerns about control and power dynamics surrounding information. CTT would suggest that the development of technologies and data-driven platforms is shaped by political, social, and economic interests. In this sense, data collection is not solely a technical process but a political one, with implications for power structures and social relations. Concentration of data in the hands of a limited number of powerful actors is to be seen as a risk, as data is often collected and controlled by large corporations, who have significant power over how data is used and who benefits from it, resulting in asymmetrical power relations, where individuals and small organizations are disadvantaged in their ability to use data for own purposes.

Additionally, CTT asserts that data gathering is more than just acquiring and handling data; rather, it requires deliberation on what data to accumulate, how to scrutinize it, and what purposes it will serve. This progression is affected by various aspects, such as technological capabilities, commercial strategies, and cultural conventions. As a result, data collection is not a neutral or objective process, but is shaped by a range of interests and values, which influences the ways in which data is used to generate profit. Data-driven platforms rely on large-scale data collection and analysis to create targeted advertising, personalized services, and other forms of value. However, this often comes at the expense of individual privacy and control over personal information. In this sense, data collection and use are often part of a broader process of extracting value from individuals and communities.

4.9 Opportunities for Secure and Transparent Data-Record-Keeping Through Blockchain

Blockchain is a decentralized, distributed ledger technology (World Bank, 2018; Investopedia, 2022) that is considered a key innovation, also in relation to digital platforms. Its origins go back to the development of Bitcoin in 2008 (Miciuła/Kazojć, 2019: 83-196), which introduced the concept of a decentralized digital currency that could be verified through a network of nodes. Blockchain was introduced to maintain a secure and transparent record of all Bitcoin transactions (cf. Vujičić et al., 2018: 1-6), providing a solution to the issue of double spending that had plagued previous attempts at digital currency. Over time, blockchain has evolved beyond its origins in digital currency to become a platform for a wide range of differing applications as the underlying technology of blockchain allows for secure, transparent, and immutable record-keeping, making it a valuable tool for industries such as finance, supply chain management, and healthcare (cf. Jadhav/Deshmukh, 2022).

One key development in the history of blockchain was the introduction of Ethereum in 2015 (Marr, 2018), which introduced the concept of smart contracts - self-executing

contracts with the terms of the agreement between buyer and seller being directly written into lines of code (Taherdoost, 2023), opening new possibilities for using blockchain to automate business processes, making it a key tool in the digital platform economy. From its inception, blockchain technology has undergone significant advancements, with the introduction of novel solutions such as permissioned ledgers and private blockchains, catering to various industry-specific requirements (cf. Amiri et al., 2021). Blockchain has also captured the attention of scholars, who are investigating its potential usage in various domains, including IP rights, voting systems, and online identity management (cf. e.g., Zheng et al., 2017:557-564; Alshamsi et al., 2022; Huang et al., 2021: 1-28). A key issue is scalability, as the blockchain's distributed nature can lead to performance issues when dealing with large numbers of transactions. Other challenges include issues around governance, interoperability (Diallo et al. 2011: 84-91; Hodapp/Hanelt, 2022), and regulatory frameworks. Despite these challenges, the blockchain remains an important innovation in the platform economy.

At its core, the blockchain is a database that maintains a continuously growing list of records, called blocks, which are linked together using cryptography (Investopedia, 2022; World Bank, 2018). Each block in the chain hereby contains a specific set of transactions, which are verified by network nodes known as miners. Miners use complex algorithms to solve mathematical problems and validate the transactions (Aljabr et al., 2019: 4293-4298), ensuring that they are legitimate and that they have not been tampered with (Zheng et al., 2017:557-564). Once a block has been validated, it is added to the blockchain, creating a permanent record that cannot be altered or deleted, achieved using cryptographic hashes (Preneel, 2010: 431-448), which are unique codes that are generated from the data in the block. Any attempt to modify the data in a block would result in a different hash.

IBM's Food Trust platform is a notable instance of blockchain being utilized in supply chain management (IBM Food Trust, 2020). The platform enables food producers and retailers to trace the origins of their products (cf. Ray et al., 2019). Using blockchain, producers can record information about the origin and processing of their products, while retailers can verify the authenticity and quality of the products they receive. Blockchain technology has also found applications in voting systems, with the potential to enhance the security and transparency of the voting process (Huang et al., 2021: 1-28). By creating a permanent, tamper-proof record of votes, the blockchain can provide a transparent and secure way to conduct elections, without the need for centralized authorities or intermediaries. The technology offers new possibilities for secure, transparent, and decentralized record-keeping, which impacts digital platforms to the extent that an increasing popularity of digital currencies (e.g., Bitcoin, Ethereum; refer to Vujičić et al., 2018: 1-6) has led to the use of blockchain technology in creating more streamlined and open payment systems in the financial industry. Platforms such as Ripple have been developed to enable cross-border payments by utilizing blockchain technology (Ripple, n.d.). In healthcare, blockchain can be used to create secure and transparent records of patient data, helping improve efficiency and accuracy of medical

records, reducing errors and ensure that patients receive the correct treatment (e.g., Guardtime, 2016).

One area of development is the integration of blockchain with other emerging technologies, such as the IoT and AI, which could create new possibilities for decentralized and autonomous systems, e.g., blockchain-enabled IoT devices could allow for secure and efficient communication and data exchange, while blockchain-based AI systems could facilitate more accurate and transparent decision-making. A burgeoning field of research centers on the emergence of blockchain-based platforms and marketplaces that facilitate decentralized and peer-to-peer exchange. These platforms have the potential to create more equitable systems of production and exchange by reducing the need for intermediaries, thereby promoting democratic digital infrastructure. However, this development also poses a challenge from the CTT perspective, as blockchain technology could perpetuate existing power structures or even create new digital oligopolies. The technology has the potential to enable peer-to-peer collaboration and exchange but may result in a small group of dominant players controlling blockchain network access and governance.

4.10 Operational Procedures of Algorithms and Types

Algorithms have become the cornerstone in the growth of the digital platform economy, serving as a critical element for several successful platforms, dating back to the period when search engines and other online services began using algorithms to provide accurate and relevant results. As the platform economy grew, however, the role of algorithms became even more important, as platforms such as TikTok (Miltsov, 2022: 664-676) and Snapchat leverage algorithms for various purposes (cf. Tilic, 2017)., such as personalized recommendations, advertising, content curation, and optimizing pricing. Advances in technology have also enabled new possibilities for algorithmic innovation, and the development of new and differing technologies (ML/AI), as these technologies allow platforms to process data in real time, enabling them to deliver more personalized experiences and optimize their services more effectively. Fairness, bias (cf. Kordzadeh/Ghasemaghaei, 2021: 1-22; Aysolmaz et al., 2020; Baer, 2019), and transparency are concerns that algorithms raise, leading to increased oversight and regulation of the platform economy, with a focus on their impact on society.

Algorithms refer to a set of predefined rules or instructions that are utilized to tackle computational problems or tasks (Simplilearn, 2023a). They are responsible for analyzing and processing vast volumes of data, and based on this, they make recommendations and decisions. They involve a sequence of steps or operations that are performed on input data to produce an output (cf. Simplilearn, 2023a). These steps can include mathematical operations, logical tests, and other computational tasks. Instructions must be unambiguous and precise to be executed properly and reflect a logic of knowledge that is based on what is deemed most important, operationalized through

filters. As a result, algorithms can favor certain interests while limiting others (Simplilearn, 2023a). In some cases, algorithms may be programmed to learn from past data and to adapt their behavior over time, using ML techniques. Search algorithms (used by search engines like Bing) are used to rank and prioritize search results based on the relevance of the content to the user's search query (Widmer, 2022; cf. Gillespie et al.,2014), using a wide range of factors to determine relevance, including keyword frequency, page authority, and user behavior. Recommendation algorithms (used by e.g., e-commerce platforms, TikTok and Netflix) are used to suggest products, services, or content to users based on their past behavior and preferences and use ML to analyze user data and to identify patterns and correlations in the data (Rocca, 2019). Fraud detection algorithms are used to identify and subsequently prevent fraudulent activity, such as credit card fraud, money laundering, and identity theft (Inscribe, n.d.).

These algorithms use a range of techniques, including ML, data mining, and statistical analysis, to detect patterns and anomalies in transaction data and to flag suspicious activity for further investigation. Thus, algorithms have far-reaching implications, producing various results such as suggesting content via search, recommending friends or romantic interests, or defining ad displays to certain groups and at certain times, they determine prices and conditions based on various characteristics of an individual or a segment they belong to. Algorithms, as such, raise important ethical and social concerns, particularly around issues of bias (cf. Kordzadeh/Ghasemaghaei, 2021: 1-22; Aysolmaz et al., 2020; Baer, 2019), transparency, and accountability. An example of how algorithms operate in practice can be demonstrated with Facebook feed, a constantly updating list of stories in the middle of the home page, showing a personalized mix of posts, photos, videos, and advertisements from the people, pages, and groups that a user follows. The feed algorithm is designed to show users the most relevant and engaging content, based on their interests and behavior on the platform and takes into account factors such as post engagement, post type, recency, and user behavior to determine which stories are displayed (cf. Majeed, 2017: 153-159), with effects such as the creation of filter bubbles (Marret, 2020), or echo chambers (cf. Bright, 2016) where users are more likely to see content that reinforces their existing beliefs and interests. The service also uses algorithms to recommend videos based on user interests and viewing history, which appear in feed like a personalized TV guide.

Recent developments in algorithms have resulted in significant advances in AI/ML, computer vision, NLP (IBM, n.d.c), and robotics. Some of the most notable developments in algorithms are deep learning algorithms, such as Convolutional Neural Networks (CNNs) and Recurrent Neural Networks (RNNs) (TELUS International, 2022) that have made significant progress in areas such as image and speech recognition, NLP (IBM, n.d.c), and autonomous driving. Reinforcement learning algorithms (Bhatt, 2018) have gained popularity particularly in robotics and gaming, using trial-and-error methods to train agents to make decisions in complex and dynamic environments. Generative Adversarial Networks (GANs) are a specific type of deep learning algorithm that are frequently being employed for tasks such as creating images and sounds,

transferring styles, and augmenting data (Brownlee, 2019). Transfer learning algorithms, on the other hand, allow pre-existing models to be adjusted for new tasks (V7labs, 2023), reducing the amounts of data and computational power that is required to train new models from scratch (Google Developers, n.d.). Evolutionary algorithms, instead, such as genetic algorithms (Dianati et al., n.d.), have been used for optimization and feature selection in ML and are applied in various fields such as finance / fintech (Planful, n.d.), engineering, and biology. All these algorithms and their impact can be seen in various applications, ranging from self-driving cars and virtual personal assistants to advanced medical diagnosis and improved supply chain management.

Algorithms analyze user data to provide personalized recommendations for products / services that are highly relevant to the unique needs and preferences of individual users. This leads to optimized user engagement, retention, and loyalty, ultimately resulting in an increase in revenue for the platform. Algorithms are employed to enhance the operations of platforms and amplify efficiency (e.g., to control inventory, distribute resources, forecast product and service demand), resulting in reduced expenses and improved profitability, and to provide users with more competitive pricing. In advertising platforms that use an auction model such as YouTube, companies offer bids on ad positions dependent on their preferred audience and the cost they are willing to pay for users to carry out a specific action, like clicking on an ad, downloading an app, or purchasing a product. The auction is run by an algorithm that considers bid amounts, ad quality, and relevance to the user. The algorithm determines the most relevant ad to show to the user based on their interests and behavior. The highest bidder wins the auction, and their ad is displayed (cf. Google Ads, n.d.).

Algorithms have further facilitated growth of new business models (e.g., ride sharing). Nevertheless, algorithms can perpetuate existing biases and inequalities, especially when they rely on historical data that reflects systemic biases, with potential negative consequences for users, particularly those from marginalized communities. Additionally, the complexity of algorithms can make it difficult to understand how decisions are made, which can erode user trust and confidence in digital platforms - items that can be perceived critically from a CTT perspective, as these influence the content that people see and the decisions that are made about them. For example, algorithms used in hiring and credit scoring can be biased against certain groups of people. CTT would rather suggest for algorithms to be subject to independent audits and that there should be greater public oversight of their development and use and proposes that alternative models of algorithm design and implementation be explored.

4.11 The Use of Artificial Intelligence and Machine Learning in Algorithmic Data Processing

Platforms such as Microsoft use AI for a wide range of functions, including NLP (IBM, n.d.c), image recognition, personalized recommendations, and fraud detection (Google Cloud, n.d.b). The development of the technology has been driven by the

availability of large amounts of data (Galloway, 2017: 196-100), improvements in computing power, and advances in ML algorithms, factors that helped to process and analyze vast quantities of data in real time, allowing them provide more personalized experiences and optimize their services more effectively (cf. Google Cloud, n.d.b, Accenture, 2015, 2020; McKinsey, 2017). Just like algorithms, the use of AI raises concerns related to ethics, bias (cf. Kordzadeh/Ghasemaghaei, 2021: 1-22; Aysolmaz et al., 2020; Baer, 2019), and accountability, e.g., that AI systems may perpetuate existing biases or reinforce existing power structures, particularly in e.g., hiring or justice.

AI refers to the creation of computer-based systems that can perform tasks that would typically require the need of human intelligence, such as perception, reasoning, and decision-making. AI today involves a combination of ML, NLP (IBM, n.d.c), and computer vision technologies (Google Cloud, n.d.b). ML is a subfield of AI that involves the development of algorithms that can learn from and make predictions based on data. These algorithms are trained on large datasets, using techniques such as supervised learning, unsupervised learning, and reinforcement learning. Supervised learning involves training a model using labeled data, where the correct outputs are already known (IBM, n.d.b), and is used in applications such as image recognition and NLP (IBM, n.d.c). Unsupervised learning involves training a model using unlabeled data, where the model must identify patterns and relationships in the data on its own (IBM, n.d.b), and is used in applications such as clustering and anomaly detection. Reinforcement learning involves training a model to make decisions based on feedback received from the environment (Bhatt, 2018), and is used in applications such as game playing and robotics. ML involves a series of steps that begin with collecting and selecting relevant data for the specific problem (Simplilearn, 2023b). Once collected, the data is preprocessed by cleaning, transforming, and formatting it, ready for model training. During training, a suitable ML algorithm is chosen, and the training data is fed into the algorithm to create a model that can make predictions or decisions based on data. Afterward, the performance of the specific model is evaluated on new data that was not used during training. Finally, the trained model is deployed into a production system where it can make real-time predictions or decisions.

NLP, an abbreviation for Natural Language Processing, is a subcategory of AI that concentrates on creating algorithms that can interpret and comprehend human language (IBM, n.d.c). NLP techniques are used in applications such as machine translation, sentiment analysis, and speech recognition. Computer vision, another subfield, focuses on the development of algorithms that can analyze and interpret visual information (IBM, n.d.c). Computer vision techniques are used in applications such as object detection, image classification, and facial recognition. Prominent examples of AI in the digital platform economy include virtual personal assistants such as Siri and Alexa, chatbots used for customer service and support, and recommendation systems used by e-commerce platforms and social media platforms. Virtual personal assistants use NLP and ML to understand and respond to user queries and commands. Chatbots (Adamopoulou/Moussiades, 2020) use similar techniques to understand and respond

to customer inquiries and can handle a wide range of tasks such as scheduling appointments, providing product recommendations, and resolving customer complaints. Recommendation systems use ML techniques to analyze user data and to make personalized recommendations for products, services, or content. These systems are used by e-commerce platforms like Amazon and Netflix, as well as social media platforms like Facebook and YouTube.

AI is utilized to forecast the products that users are more probable to buy, the advertisements they are more likely to click on, and the content that they are more likely to interact as well as engage with. AI has also been utilized to improve customer service and respective support. Chatbots and virtual assistants powered by AI (Agarwal et al., 2022) can respond to user inquiries and help in real-time, 24/7 (Aisera, n.d.). This has helped businesses to reduce response times, improve user satisfaction, and reduce the burden on human customer service representatives (Aisera, n.d.). Furthermore, AI has paved the way for novel offerings and solutions within the digital platform economy. As an illustration, AI-enabled online marketplaces such as Amazon have empowered enterprises to peddle their merchandise to shoppers worldwide (Galloway, 2017: 13-62, 190), irrespective of geographical limitations or time discrepancies (Builtin, 2022). AI-powered financial services like robo-advisors have enabled users to manage their investments more effectively (Forbes, 2023), with lower fees and higher returns. Nonetheless, the utilization of AI in the digital platform economy has given rise to apprehensions concerning privacy, security, and responsibility (cf. Issues in Science and Technology, 2017). AI algorithms require large amounts of data to function effectively, and there are concerns about how this data is collected, stored, and used (Vanhaelen et al., 2018; Zhe, 2019). Additionally, the complexity of AI algorithms can make it difficult to understand how decisions are made, eroding user confidence.

The development of AI, as pointed out, is driven by a strong desire for efficiency and profitability, as noted by the CTT, rather than the pursuit of social good or individual empowerment. AI has been viewed as a means of automating tasks, which can contribute to inequality and insecurity in the job market (cf. McKinsey Global Institute, 2017a; 2017b). The utilization of AI in the digital platform economy reinforces the supremacy of major technology firms, who leverage the technology to gather and exploit user data for financial gain, raising concerns about privacy and accountability. These companies use algorithms and ML to optimize advertising, personalize content, and manipulate behavior (cf. Hamann, 2018), raising concerns around privacy and bias (cf. Kordzadeh/Ghasemaghaei, 2021: 1-22; Aysolmaz et al., 2020; Baer, 2019).

4.12 Augmented Reality, Virtual Reality and Developments Towards a Metaverse

The development of VR and AR has been a key driver of innovation in the digital platform economy and has opened new possibilities for creating immersive and engaging experiences for users (Financely Group, 2022). VR is a technology that creates

a complete, simulated environment that users can fully engage in, while AR superimposes digital objects onto the real world (McKinsey & Company, 2021). In recent times, AR/VR have found applications in various fields such as gaming, entertainment, education, and training (Voštinár et al. 2021: 137-146). Companies such as Meta and Apple (Galloway, 2017: 63-95) are investing heavily in the development of AR/VR technology and are exploring new ways to integrate these technologies into their existing platforms and services (MakeUseOf, 2022).

AR and VR are two types of technology that offer users a way to interact with digital environments, though they have different methods and degrees of immersion (McKinsey & Company, 2021). AR technology involves layering digital information over the real world, which is often achieved using smart glasses or mobile devices (Investopedia, 2022). This technology relies on computer vision and image recognition systems that can accurately identify and track real-world objects. AR has many uses, including gaming, education, and commerce, and can be seen in applications such as Pokémon Go (Hamari et al., 2018: 804-819), Snapchat filters, and IKEA's AR furniture app (Ozturkcan, 2021: 8-13). VR, on the other hand, creates fully immersive digital environments that users can interact with through a VR headset (Iberdrola, n.d.), which requires advanced hardware technologies such as high-resolution displays, motion tracking sensors, and haptic feedback devices, as well as sophisticated software tools such as 3D modeling software, physics engines, and VR content creation tools. VR applications (e.g., Oculus VR, HTC Vive, PlayStation VR, cf. The Guardian, 2016) can be used for a considerable scale of different purposes (gaming, education, and training, among others).

While not a specific technological element, it is crucial to recognize the progress made toward the metaverse considering the advancements in technology, particularly in AR/VR encounters (cf. Bobier et al., 2022; Dionisio et al., 2013; Launay/Mas, 2008; Slater/Usoh, 1993: 90-96; Thompson Intelligence, 2021). The concept of the so-called metaverse has been around for decades (cf. Ravenscraft, 2022; McKinsey & Company, 2021; Ball 2020, 2021a, 2021c), the term was first used in the 1992 sci-fi novel Snow Crash (Stephenson, 2000), but with the recent advances in AR/VR the idea is brought closer to reality. The term metaverse refers to an all-encompassing virtual reality space where users can engage with each other and digital content in a fluid and interactive manner (Ravenscraft, 2022; Ball, 2020, 2021a, 2021c). This virtual world is considered as an ultimate version of the internet that enables people to work, socialize and have fun without being constrained by geographical and physical limitations (Ball 2020, 2021a, 2021c; Financely Group, 2022; McKinsey & Company, 2021).

The metaverse, AR, and VR are all related concepts that involve creating immersive digital experiences for users (McKinsey & Company, 2021). Despite the variations in their size and technological intricacy, all these virtual environments depend on cutting-edge software and hardware to create convincing and interactive experiences. Consequently, the metaverse is a phrase that is referring to a digital world that is utilized by numerous users and can be accessed via different devices, including

smartphones, computers, and virtual reality headsets (Dean, 2021). Additionally, users can navigate through worlds generated by different creators (Hackl, 2021), e.g., from Fortnite to Roblox to Horizon Worlds with the same avatar identity (cf. Iterators, 2022, requiring, however, interoperability). The technical implementation of the metaverse involves creating a complex network of interconnected digital environments that users can explore, interact with, and modify in real-time (McKinsey&Company, 2021). This requires sophisticated networking technologies such as cloud computing, edge computing, 5G wireless networks, and advanced software tools like game engines, graphics rendering engines, and AI-based content creation tools (McKinsey&Company, 2021). Prominent examples of metaverse platforms include Fortnite, Second Life, Roblox, and Decentraland (Inglobe Technologies, n.d).

The potential of the metaverse is vast (National Research Group, 2021), and the cited experts (cf. Ravenscraft, 2022; Ball 2020, 2021a, 2021c) establish that the metaverse has the potential to bring about a significant change in the way we engage with technology and with one another (Schmidt/Banusch, 2022). It is imagined as a space where individuals can communicate, socialize, and conduct business without the limitations of physical distance or location. It could be used for everything from socializing and entertainment to education and training. The metaverse is envisioned as a seamless extension of the internet, with its own virtual economy, social norms, and laws. The concept of the metaverse has gained popularity due to the potential it offers for social interaction, entertainment, and business, and has become a subject of interest and investment for technology companies and investors. Despite its potential benefits, the metaverse is still in its nascent stages, and there is currently no established consensus or framework for how it should be defined or regulated.

According to Ball (2021a), the metaverse is a collection of immersive virtual spaces that are persistent and shared, accessed by users through various devices. The essential elements of the metaverse according to the author are: 1) it consists of virtual spaces that exist independently of any single user or device, allowing multiple users to access them simultaneously; 2) users in the metaverse are represented by avatars, which are digital representations of themselves that can move around and interact with other users and virtual objects; 3) the metaverse is characterized by interactivity, with users able to interact with virtual objects and with other users in real time; 4) the metaverse may include a virtual economy, with users able to buy and sell virtual goods and services using virtual currency. Ball also identifies several key trends in the development VR, AR, and blockchain (Ball, 2021c). Ball also emphasizes that the metaverse is being designed as a social space, with a focus on fostering social interaction and community building. As the metaverse develops, there can be a growing need for content creators to design and populate virtual spaces with engaging content. In relation to monetization, Ball sees opportunities through the sale of virtual goods and services or through advertising. Ultimately, the metaverse is a collaborative effort, shaped by a wide range of differing players across different industries that are working on solutions at the same time.

The metaverse has emerged as a promising prospect for the future of digital platforms, presenting the potential to transform how individuals interact with each other, as well as how businesses operate. It offers a new realm for innovation and entrepreneurship, with potentially significant economic implications. The metaverse could provide new opportunities for companies to engage with customers and create immersive experiences that cannot be replicated in the physical world. Additionally, it could serve as a new marketplace for digital goods / services, further driving economic growth. As such, the metaverse has the potential to reshape not only the digital platform economy but also society. It could enable new forms of social interaction and facilitate greater collaboration across geographic and cultural boundaries, having implications for education and training, as immersive simulations could provide new opportunities for learning and skill development. As the evolution of the metaverse progresses, it is crucial to consider its wider societal effects and strive for equitable distribution of its advantages. Case studies of existing metaverse platforms and their impact on various aspects of the digital platform economy can provide valuable insights into the potential benefits and risks of this new frontier. Furthermore, these insights can assist policymakers in making informed choices and shaping ethical standards that guarantee the responsible and fair utilization of the metaverse.

Overall, while the history of the metaverse, along with VR and AR, in relation to the digital platform economy has been one of rapid innovation and experimentation (McKinsey&Company, 2021; Feifei, 2021), its development raises several insecurities and issues (Madiega et al., 2022), especially related to privacy, security, and ethics. There are concerns that the metaverse could become a platform for abuse and harassment, and that it could be used to reinforce existing power structures and inequalities. As a reaction, governmental bodies and regulators are starting to contemplate the practicalities of supervising and regulating the metaverse. They are suggesting novel policies and subsequent regulations to ensure the metaverse is open and answerable while concentrating on broadening the variety and inclusivity in the design of metaverse platforms (Madiega et al., 2022). Also, when taking the perspective of the CTT (as it is discussed within chapter 3.2 of this study), the Metaverse, AR, and VR can be viewed as technologies that are embedded in and influenced by the broader social, economic, and political streams (cf. Madiega et al., 2022), again subject to interests and power relations of those who develop and control them.

5 TECHNOLOGICAL IMPACT ON THE DIGITAL PLATFORM ECONOMY

5.1 Mapping Effects and Economic Impact of Technology on Digital Platforms

It is imperative to comprehend the effects of technology on the economy, particularly the digital platform economy, for various reasons. The rise of digital platforms has transformed the way in which businesses operate, with platforms such as Amazon, Uber, and Airbnb disrupting traditional industries and business models, creating significant opportunities for new entrants and innovative startups. Simultaneously, it poses significant inquiries regarding the position of these platforms in the wider economy. The economy driven by digital platforms has emerged as a contributor to economic expansion, with many countries seeing the rise of the digital economy as a key source of future prosperity, leading to significant investment in digital infrastructure and innovation, with governments and businesses alike recognizing the importance of staying competitive.

In the digital age, the consequences of technology and on the digital platform economy carry significant social and cultural implications, especially regarding how individuals engage with businesses and each other. For instance, the ascent of social media platforms has transformed the modes in which people access and exchange information, while the emergence of novel online work models has disrupted traditional employment patterns, prompting concerns about the future of work. Finally, understanding the impact of technology on the economy is important from a policy / legislation and intervention perspective. To formulate suitable policies that guarantee equitable distribution of benefits and efficient management of risks arising from the utilization of platforms, it is imperative to have a profound comprehension of the economic, social, and cultural forces at work within the digital platform economy. This entails a readiness to participate in continued dialogue and teamwork with significant players in the business world, non-governmental organizations, and scholarly circles.

The digital platform economy is a multifaceted and swiftly changing terrain that encompasses a broad array of markets, enterprises, and technologies. Understanding this ecosystem requires a nuanced approach that considers a range of factors, including market dynamics, multi-sided markets, network effects, value exchange, scalability, data exploitation, ecosystems, concentration, intervention, legislation, terms of service and the future of work.

1) A general market overview (refer to chapter 5.2) is necessary to understand the digital platform economy, as it includes identifying major players, market trends, and related technologies. It is crucial to acknowledge the dynamic nature of the platform economy, as new disruptive technologies and entrants regularly emerge to challenge established players. The digital platform landscape encompasses various types of platforms, including app markets, e-commerce marketplaces, social media platforms, matching platforms and other online marketplaces, the audio and video platform markets, as well as markets for AI, AR/VR and the metaverse.

2) Dominant platforms and large market shares (refer to chapter 5.3.1) are observable and, as such, an important in the digital platform economy as they can influence competition and innovation. They can bring benefits to users, but also pose risks such as reduced choices and limited innovation.

3) Multi-sided markets (refer to chapter 5.3.2) are a key feature of the digital platform economy, as these are markets that involve two or more distinct user groups that depend on each other to create value. Digital platforms facilitate interactions between these groups, often providing services or infrastructure that enable them to communicate, transact, or collaborate.

4) The success of multi-sided markets is often driven by network effects (refer to chapter 5.3.3), which occur when the value of a platform increases as the number of its users grows. In the case of digital platforms, network effects arise if a platform or a product acquires more users, which subsequently boosts the platform's value for both its users and producers.

5) The exchange of value (refer to chapter 5.3.4) is an essential and constitutional element of the economy of digital platforms, given that platforms often rely on different models for generating revenue, including advertising, commissions, subscriptions, or data sales. The intricate value exchange that takes place among users, platform proprietors, and other parties is frequently affected by various elements, such as market dominance, cost determination, and user satisfaction, making it a multifaceted aspect of the digital platform economy.

6) Scalability (refer to chapter 5.3.5) is a meaningful mechanism and concept in the digital platform economy since digital platforms often aim to scale quickly, growing their user base and expanding their services or features. However, this rapid growth can create challenges, including technical infrastructure issues, regulatory compliance, and managing user experience as the platform becomes more complex.

7) The issue of data exploitation (refer to chapter 5.3.6) is a significant and inherent concern, considering that digital platforms frequently gather substantial quantities of information about their users, which can be used subsequently to obtain valuable information, customize ads, or innovate new products. However, the collection and use of this data raises a range of ethical and legal questions.

8) Ecosystems (refer to chapter 5.3.7) are a crucial aspect of the digital platform economy. Platforms often operate within larger ecosystems, which can include complementary or competing businesses, regulatory bodies, and user communities. Understanding dynamics of these ecosystems is critical for predicting market trends and identifying growth opportunities.

9) Concentration (refer to chapter 5.3.8) is a result within the digital platform economy and needs consideration as it can impact competition, innovation, consumer choice, and privacy. Multi-sided markets facilitated by digital platforms are at the core of this economy, and concentration can lead to negative outcomes such as reduced quality, higher prices, and limited consumer options.

10) Legislation (refer to chapter 5.4.1) is crucial in governing the digital platform economy and protecting users from anti-competitive practices and privacy concerns. It provides a framework for healthy competition and ensures that platforms adhere to data protection and security standards.

11) Intervention (refer to chapter 5.4.2) is an important consideration in the digital platform economy. Given the potential for market power and the sensitive nature of user data, many governments and regulatory bodies are exploring ways to regulate digital platforms. This can involve probes into anti-competitive practices, legislative measures on data protection, or other types of regulatory actions.

12) Platform Terms of Service (refer to chapter 5.4.3) govern the relationship between platforms and their users, including policies around data privacy, intellectual property, and dispute resolution, thus serving as the underlying contract for usage of platforms.

13) Additionally, the employment practices (refer to chapter 5.4.4) of platform companies, including the use of independent contractors and the impact on traditional labor markets, have become subject of increasing scrutiny.

A deeper understanding of the digital platform economy requires a multifaceted approach that considers these factors collectively. Understanding these factors from the perspective of CTT can provide several benefits for understanding the impact of technology on the digital platform economy. The CTT adopts a critical stance towards technology and its impact on society. Examining the relationship between technology and society from this perspective can reveal power imbalances, social and economic disparities, and possible adverse consequences associated with the use of technology in the digital platform economy. The CTT can help shed light on the underlying assumptions and values that shape technological development and use in the digital platform economy and can help to identify potential risks and challenges associated with technology in the digital platform economy, such as issues related to privacy, data security, and future of work. Based on these perspectives, a more comprehensive and nuanced understanding of the digital platform economy can be developed to help identify potential opportunities for innovation, collaboration, and cooperation that can promote more sustainable and socially responsible technological development and use.

5.2 A General Market Overview of the Digital Platform Economy

5.2.1 Application Systems, Market, and Usage of Mobile Apps

The application systems and mobile apps market is a rapidly growing industry that provides software solutions for businesses, governments, and individuals. It includes a variety of software applications that enable organizations to manage their operations, automate tasks, and improve productivity. The market for application systems and apps is driven by the growing demand for technology solutions that can streamline business processes, enhance efficiency, and drive innovation. The structure of the application systems market is diverse and includes both large established players and smaller startups. The market is highly competitive, with new players entering the market and existing players constantly innovating and improving their offerings. The market is also highly fragmented, with different players specializing in different application areas, such as customer relationship management, supply chain management, HR management, and financial management.

Some of the most important players in the larger application systems market in terms of software supply include SAP, Oracle, Microsoft, IBM, Salesforce, and Workday. These companies have considerable market share and are among the leaders in their respective areas of specialization. SAP is a prominent player in the domain of enterprise resource planning (ERP; cf. Ullah et al., 2018: 4399-4406) software, whereas Salesforce holds a dominant position in customer relationship management (CRM; cf. Saarijärvi et al., 2013) software. The market for OS and apps is highly concentrated. In 2018, Android reached 40% of the market, surpassing Microsoft's OS market share of 36.7%. As of June 2020, Android still had a market share of 38.3%, with Microsoft at 36.55%, effectively forming a duopoly, accounting for almost two-thirds of the market share. Apple's iOS held a distant ranking place, with a limited market share of only 14.3% (Statcounter, 2020b). In mobile, Alphabet's Android holds almost total control. Android's dominance in the device market has contributed to its success. In 2022, Android was installed on 71.8% of devices, while iOS was used on 27.6% (Statista, 2023a). In terms of web access, 74.14% of connections are made through Android, 25.26% through iOS, followed by Samsung (0.21%) and KaiOS (0.13%) (Statcounter, 2020a). In recent years, the application segment has seen an influx of offerings. The number of apps available in the Apple store increased from 15.3k in 2008 to 3.062m in 2019, while the number of apps available in the Play Store rose from 16k in 2009 to 2.96m in 2019 (Statista, 2020d). Play Store is pre-installed on Android driven mobiles and, therefore, has the same distribution as the OS, reaching 2.5b users. In August 2020, the Google Play Store alone had over 3b apps, with 2.8b of them being free and only 4% (118,920) being paid apps (AppBrain, 2020).

Global smartphone users downloaded over 200b mobile apps in 2019, with a total spending of $120b on apps and related purchases, video apps dominated the top 10 non-game apps ranked by consumer spending, with five of them being video apps (Kemp, 2020). Among them, Tencent Video, iQiyi, and Youku are most popular among Chinese internet users. The most downloaded free apps in 2019 were social networks

and messaging apps, including Messenger, Facebook, WhatsApp, TikTok, Instagram, Share It, Likee, Snapchat, Netflix, and Spotify. Users tend to concentrate their app consumption on only a few applications, with the top 10 consuming 95% of the time of use, and half of the time spent on the most-used application by the user. Users spend an average of 3h and 40min each day using mobile devices. Of this time, 50% is spent on social and communication apps, 21% on video and entertainment apps, 9% on gaming apps, and the remaining 19% on other types of apps (Kemp, 2020). The report also highlights that video apps accounted for 5 of the world's top 10 non-game apps by consumer spend, with three of them - Tencent Video, iQiyi, and Youku.

In terms of economic groups, Meta dominates the market with its top three apps: WhatsApp, Facebook, and Instagram. Facebook ended 2022 with 2.96b MAU (DAU represented about 66% these), WhatsApp is the second largest service of the platform and third in the global ranking, with 2.0b users (all these are active, Statista, 2022a). The messaging service is available in 180 and is the most popular messaging app in all but 25 of these (ThinkImpact Report, 2022). Over 100b messages are exchanged on WhatsApp daily, 22% of WhatsApp users are on Apple iOS, compared to 73% that are on Android (ThinkImpact Report, 2022). In 2021 there were 600m downloads of WhatsApp, ranking first in relation to the most downloaded apps under the Meta owned and operated applications (7.5%, or 45m of these downloads occurred in the US). WhatsApp ranked third in overall downloads of messaging apps in the US, just behind Messenger. A year before its $19.3b acquisition by Meta, WhatsApp was valued at $1.5b after a funding round (ThinkImpact, 2022). WhatsApp today continues to be the most popular service in several countries, such as Canada and Mexico, all South America, much of Western Europe, most African nations, Russia, and India (cf. Kemp, 2020). Instagram follows soon after, having hit the 1b user mark in 2019, and accounting for 1.478b today (Statista, 2022a). The digital social network has multiplied its base by 16 in 8 years, having grown from 90m in 2013 to over the 1b mark in 2019 to its user base today (Statista, 2022a). Messenger is the company's fourth largest service, with 988m in 2021 (Statista, 2022a).

The requirements of clients in the market for application systems are diverse and depend on the sector and the specific application domain. Generally, customers are looking for software solutions that can help them improve productivity, reduce costs, enhance customer experience, and improve decision-making. In addition, customers are increasingly looking for cloud-based solutions that offer flexibility and scalability. The dynamics and market trends in the application systems market are driven by several factors, including changing customer needs, technological advancements, and evolving business models. One major trend is the shift toward cloud-based solutions, which offer several advantages over traditional on-premise software, including lower costs, easier maintenance, and greater scalability. Another observable trend at present is the increasing use of technologies like AI/ML in software applications, which can help organizations make better decisions and automate tasks more effectively. Additionally, the rise of the gig economy (Bulian, 2021: 106-119; Janadari/Preena, 2020: 1-

14; Ostoj, 2021: 451-462) and remote work has created a demand for mobile and flexible software solutions that can be accessed from anywhere.

5.2.2 The E-Commerce Market and the Dominance of Large Multinational Corporations

The e-commerce market is a rapidly growing industry that has transformed the way people shop and do business. The industry is characterized by a complex structure and a highly (or hyper-) competitive landscape that includes large multinational corporations and small niche players. Success in this market depends on putting customers at the center of the value proposition, and providing a shopping experience that is both seamless and convenient. The e-commerce market can be broadly categorized into two segments: Business-to-Consumer (B2C) and Business-to-Business (B2B). In the B2C segment, retailers offer products / services directly to consumers through online channels, while in the B2B segment, companies sell products and services to other businesses through online platforms. According to Statista, the e-commerce market mobilized $1.3t between 2014 and 2021, and it is projected to reach $4.48t, a 3.4x increase (Statista, 2018a). In 2015, e-commerce represented only 7.4% of total retail sales, but rose to 15.5% by 2021 (Statista, 2020i). Globally, e-commerce retail accounted for 14.1% of total aggregated sales in 2019, and this level is expected to potentially reach 22% by end of year 2023 (Statista, 2020i). Sales volume reached $4.5t by 2021, which is a 300% increase from the $1.33t recorded in 2014 (Statista, 2020k). The largest market in 2016 was China, with $975b in e-commerce sales, followed by the US ($648.6b), the UK ($192.5b), Japan ($124.4b), France ($79.1b), Germany ($74.1b), South Korea ($71.3b), Canada ($43.5b), India ($44.7b) and Russia ($24b) (Statista, 2020j). Today, following data points gathered from eMarketer, the top 5 markets are China, with $2.78t in annual online sales, with e-commerce accounting for 52% of total retail sales, the US ($843b /19%), the UK ($169b/4.8%), Japan ($144b/3%), and South Korea ($120b/2.5%) (Business.com, n.d.).

The competitive landscape of the e-commerce market is being dominated by select large players, such as Amazon, Alibaba, and eBay, which have a significant market share in various regions of the world (cf. Galloway, 2017: 13-62, 190). A survey by Statista showed that the e-commerce market was led by Chinese Taobao and US-based Amazon, each with a 16% market share. Chinese TMall (11%), JD (5%), and eBay (4%) followed suit (Statista, 2018a). The first five competitors in the market accounted for 52% of total sales, and other providers accounted for the remaining 39%. The e-commerce sector is complex due to the range of products and the delivery logistics, which can increase the costs of globalized operations. These companies have developed vast ecosystems that encompass everything from online marketplaces to cloud services and logistics networks. Other players in the market include niche players and startups, which specialize in specific product categories or offer unique value propositions to customers. For large e-commerce platforms, the internet is the place to promote their services using personalized and ever-present ads that are increasingly

part of consumers' daily lives. People use the web not only to buy products but also to research prices and product information, even if they ultimately purchase in a physical store. Price comparison websites have emerged as marketing channels that require significant investments in payment and security infrastructure, data storage and processing capabilities, product flow control, and delivery organization, making it tough for small businesses to compete at a national or global level (cf. Bodur et al., 2014; Kim/Ha, 2014).

While online commerce represents cost reduction opportunities and sales optimization for companies, there are product types that still require closer contact with the consumer, such as food and to some extent, clothing. Although online shopping has its conveniences, such as not needing to travel to acquire a product, there are certain product categories where the need for physical examination may still prevail. The e-commerce industry is centered on fulfilling the needs and desires of customers, and companies that can offer a streamlined and hassle-free shopping process are poised for success. These companies must provide quick and dependable shipping, simple return policies, tailored suggestions, and secure payment methods. Furthermore, consumers are becoming more conscientious about environmental and ethical concerns, leading to a rise in businesses that specialize in sustainable and socially responsible products. Despite the higher pace of growth, there are still significant barriers to consumer purchasing practices.

The dynamics of the e-commerce market are shaped by technological innovation, changing consumer behavior, and regulatory frameworks. The industry is characterized by rapid innovation and adoption of new technologies, such as AI, blockchain, and the IoT. Consumer behavior is also changing, with a growing preference for mobile shopping and a desire for more personalized and relevant experiences. Regulatory frameworks are also shaping the market, with issues such as data privacy, consumer protection, and taxation being key areas of concern. The e-commerce market is anticipated to sustain its rapid growth trajectory in the foreseeable future, as elaborated by the market trends observed. This growth is driven by increasing internet penetration, rising disposable incomes, and the growing popularity of online shopping. The COVID-19 pandemic has also accelerated the shift towards e-commerce, as consumers have been forced to shop online due to lockdowns and social distancing measures. The ability to provide a seamless as well as convenient shopping experience is crucial for success in this market, and companies that can innovate and adapt to changing customer needs and regulatory frameworks are well positioned for success.

5.2.3 Website, Browser and Search Engine Usage Indicating Platform Hegemony

The market for the most visited websites includes some of the most well-known and frequently used websites on the internet, such as Google, YouTube, Facebook, and Amazon. The websites of these digital platforms have enormous amounts of traffic and

have become essential parts of people's daily lives. Understanding the structure, competitive landscape, most important players and their performance, customer needs, and dynamics and market trends of this market is essential for businesses looking to enter or compete in this space, which is largely dominated by digital platforms.

The market for the most visited websites is composed of select dominant players that have established themselves as household names. These players have a large market share and significant control over the direction of the market. The structure of this market is constantly evolving as well, as new players emerge, and existing players adapt to changing trends and customer needs. According to the Alexa Internet Database (2020), which belongs to the Amazon conglomerate, the list of the most visited sites in the world is dominated by Alphabet (including Google and YouTube), Tmall, Baidu, QQ, Facebook (owned by Meta), Sohu, Login.Tmall, Taobao, Yahoo, 360, JD, Amazon, and Wikipedia. Google was ranked as the world's most visited website, with users spending an average of 12min and 9sec per visit (based on global website traffic), with 14.64 pages/day. Similarweb list 8.12 pages/visits, and 10min and 20sec spent. This suggests that the search activity is significant, with more than 4.5b internet users performing searches daily (Kemp, 2020; Statcounter, 2020b). YouTube ranks second, with 6.70 pages/day and 11min and 44sec spent (Alexa Internet Database 2020) and 9.69 pages/visit and 23min spent according to Similarweb (Kemp, 2020). Among the twenty most accessed sites, all are platforms, with two belonging to Alphabet (Google.com and YouTube.com), nine being American, and eleven Chinese. Two of the platforms are search engines (Google and Baidu), five are e-commerce platforms (Amazon, Taobao, Tmall, and their affiliated pages), one is a social network (Facebook), and three are content-sharing platforms (YouTube, Reddit, and Wikipedia). The remaining three are multi-service platforms and portals, including QQ, Sohu, and Sina Weibo from China, and Microsoft's Live.com. The high volume of access of some lesser-known platforms, such as Baidu and QQ, could be due to their presence in China, the world's most populous country, including its diaspora.

Chrome has grown to become the dominant player in the browser market, reaching over 50% market share in October 2016 and 65.52% in June 2020, according to Statista (2020g). Chrome dominates both the desktop and mobile browser market, with a 69.89% global desktop market share and a 60.26% share in the mobile browser market (Ikoba, 2020). Its closest competitors, including Safari, Firefox, Samsung, UC Browser, Edge, Opera, Internet Explorer, and Android, had much lower market shares. The data also shows the rise of Chrome and the fall of Microsoft's Internet Explorer, which was replaced by the new browser, Edge. Google dominates the search engine market with over 3.2b users (cf. Statista, 2021a), the closest competitors being Bing (2.75%), Yahoo! (1.7%), Baidu (1.02%), and Yandex (0.47%) (Statcounter, 2020b). In the cloud services market, Alphabet’s GCP ranked third in Q1 2020, with an 8% market share, behind AWS (32%) and Microsoft (18%), as reported by Statista (2020h). Research suggests that GCP’s market share in cloud services in 2020 was 9% (compared to 8% in 2019), placing it third behind AWS (63% in 2019), and Azure (29% in 2019) (Dignan,

2020). Alphabet dominates the digital advertising market, accounting for 37% of the total $130b US digital advertising market and 80% of the US market for search ads, while Meta's targeted advertising using consumers' demographic information and location makes it an attractive option for advertisers (Investopedia, 2020; Bain 2019), so that the two enterprises effectively form a duopoly in the digital advertising market (cf. Galloway, 2017: 113). In Q4 2021, through this dominance, Google's search business generated a revenue of $43.3b, up 36% year over year (Spangler, 2022).

As such, the competitive landscape of this market is intense, with a few dominant players vying for market share. These players are constantly competing through innovation, expansion into new markets, and M&A. For example, Amazon's acquisition of WholeFoods (cf. White, 2020) was seen as a move to expand into the grocery market and compete with established players like Walmart (Galloway, 2017: 220-221) and Kroger. As demonstrated, the most important players in this market are Google, YouTube, Facebook, Amazon, and several others. While YouTube is the dominant video-sharing platform, Facebook is the dominant social media platform, and Amazon dominates e-commerce (cf. Galloway, 2017: 13-62). Each of these players has a unique business model and generates revenue through different means, such as advertising, e-commerce, and subscriptions. These players have seen tremendous growth in recent years, with their revenues and market capitalizations reaching unprecedented levels (cf. Paul, 2018: 600-608).

Customers in this market have a wide range of needs, including search and discovery, social connection and interaction, e-commerce, entertainment, and more. All major companies in this market have customized their offerings to satisfy these requirements. For example, Google's search engine is designed to help users find information quickly and easily, while Meta’s social media platforms are designed to help users connect and interact. The market for the key websites is evolving, with new players entering the market and existing players adapting to trends and needs. The movement towards mobile devices has been one of the most significant changes in the last few years, with an increasing number of users accessing the internet and using these websites on their smartphones and tablets. Also, there has been the increasing importance of data and privacy concerns, with customers becoming aware of how their data is being used and demanding greater control over their personal information.

5.2.4 Owners of Multiple Social Applications Dominate the Digital Social Network Market

The market for digital social networks is a rapidly changing and extremely competitive arena, marked by the existence of a multitude of players, including well-established tech behemoths as well as fledgling startups. The market is driven by the increasing adoption of social media platforms (e.g., TikTok, Facebook, Instagram, Twitter, Snapchat, and LinkedIn), the rise of mobile devices, and the growing demand for digital connectivity and online engagement. In terms of the market structure, the digital

social network market is characterized by a diverse range of platforms that offer a variety of services and features, including social networking, messaging, photo, and video sharing, and content creation. The competitive landscape in the digital social network market is intense, with few dominant players competing for market share and driving innovation in the industry. It is essential to recognize that digital social networks do not reveal the exact number of advertisers when studying the advertising market. However, a survey by Bain (2019) revealed that Facebook is the preferred advertising platform among marketing executives (cf. Galloway, 2017: 113-114).

Meta, the parent company of Facebook and Instagram, is the market leader in the digital social networking industry, boasting about 3b users on Facebook alone (Meta, 2023). Twitter, Snapchat, and LinkedIn (Galloway, 2017: 223) are other significant players in the market. Facebook holds a significant advantage in the digital social network market with 2.910b users, followed by YouTube (2.562b), WhatsApp (2.0 b), Instagram (1.478 b), Weixin/WeChat (1.263 b), TikTok (1.0 b), Messenger (988m), Douyin (600m), QQ (574m), Sina Weibo (573m), Kuaishou (573m), Snapchat (557m), Telegram (550m), Pinterest (444m), Twitter (436m), Reddit (430m), and Quora (300m) (Statista, 2022a). To compare the groups which own more than one of the mentioned digital social networks, as a key platform indicator, revenue figures can be observed. Meta's dominance in the digital social network market becomes more apparent when compared to the revenue of other players. In 2019, the company's revenue was $70.7b, which includes Facebook, Messenger, WhatsApp, and Instagram, while Tencent's revenue was $54.08b, including Qzone, QQ, and WeChat. For comparison, Netflix generated $20.16b in revenue, and Google $160.74b. Alibaba, a Chinese e-commerce provider, earned $71.99b in revenue, and Amazon.com ranked first with $280.5b in annual revenue (Statista, 2020c).

Customer needs in the digital social network market are varied and evolving, with users looking for platforms that offer engaging and personalized experiences, as well as robust privacy and security features. Social media platforms are expanding their usage beyond just socializing and are now being utilized for various differing purposes such as entertainment, and news consumption. One of the key dynamics in the digital social network market is the emergence of new features and services that are designed to enhance user engagement and drive revenue growth. Many platforms are investing heavily in areas such as video content, AR/VR, and e-commerce capabilities to stay competitive and attract novel users. Market trends in the digital social network market are largely driven by user behavior and evolving consumer preferences. As more users shift their attention to mobile devices and given the fact that they spent an increasing amount of time on social media platforms, there is a mounting need for effortless and customized experiences that are accessible at any time and from any place. In addition, there is increasing scrutiny around issues such as data privacy, misinformation, or online harassment, which is driving platforms to invest in stronger security and moderation.

5.2.5 Matching Services and Online Marketplaces that Enable Peer-to-Peer Transactions

The matching services market or online marketplaces refer to a growing sector of the economy that includes various online platforms and mobile applications that facilitate sharing, renting, trading, and exchanging goods / services among individuals and organizations. The market is witnessing novel business models that exploit technology to facilitate peer-to-peer transactions and connect users. The market is composed of diverse segments that offer various platforms and services that differ in focus, target demographic, and revenue models. Possible examples of these would include ride-sharing platforms (e.g., Grab), home-sharing platforms (e.g., Airbnb or Booking), and peer-to-peer lending platforms (e.g., LendingClub). The competitive landscape of the collaborative services market is highly dynamic, with new entrants and startups competing against incumbents. While some companies have achieved dominant positions in certain niches of the market, such as Uber in ridesharing (cf. Dudley et al., 2017) and Airbnb in home-sharing, the barriers to entry are relatively low, and new players can quickly enter the market and disrupt the status quo.

The most important players in the collaborative services market include both established companies and startups. In addition to Uber and Airbnb, other major players in the market include Etsy (Church/Oakley, 2018: 1-21), TaskRabbit, Zipcar, and WeWork, among others. These companies are characterized by their use of technology to create network effects and enable efficient matching between buyers and sellers. Private paid transportation services like Uber and Lyft were successful due to the shortcomings of traditional cab services in terms of pricing and availability (Kooti et al., 2017: 574-582). However, the nature of the services varies widely, from those that offer full-time jobs to drivers, such as Uber, to those that are more like casual arrangements (cf. Dudley et al., 2017). Uber operates in over 900 cities (Uber, 2020) and recorded over 6.9m trips in 2019 (Iqbal, 2020a). According to Arevalo (2020), Lyft has completed more than 1b rides since its inception, while Uber has completed over 10b. Furthermore, in the US, a third of car owners could save money by using private paid transportation services instead of their own vehicles.

According to Varun (2018), 53m people in the US workforce (34%) work independently through various forms of freelancing, transacting $715b in Gross Merchandise Volume (GMV), mostly through offline and personal networks. In the personal services sector, Uber has emerged as the most effective labor marketplace (Kooti et al., 2017: 574-582), while Upwork remains the dominant freelancer website globally, facilitating over $1b in online technical work transactions. Thumbtack, with over $1b in transactions, is considered an innovative business model. On the other hand, AngiesList and TaskRabbit are experiencing a downward trend with less than 4% of the US population using these services. Craigslist is more popular, with thousands of times more monthly active visits, while Fiverr appears to be on a growth trajectory. According to Varun (2018), Craigslist is the most visited website, with 863.9m, followed by Kijiji (95.22m), Upwork (34.23m), and, lastly, TaskRabbit (824k). In terms of market share

by average monthly visits in the transportation sector, the main one is Uber (49.1m), followed by Lyft (13.2m), Postmates (2.6m), Instacart (2.1m), and Doordash (1.9m). Despite this, Craigslist is the dominant marketplace in the US, with over 700m monthly visits and more than 60m classified ads posted each month (Varun, 2018). In the learning area, Khan Academy dominates with a 55% market share, while in customized goods, the market is monopolized by the Etsy platform with a 91% share (cf. also Church/Oakley, 2018: 1-21).

As such, the performance of the matching services market or online marketplaces has been robust in recent years, driven by a combination of technological innovation, changing consumer preferences, and the growth of the sharing economy (cf. Agarwal/Steinmetz, 2019; Hamari et al., 2016: 2047-2059; Schor et al., 2015: 12-19). The market has also faced challenges, including regulatory hurdles and concerns over labor practices and data privacy. Customer needs are diverse, but generally focus on convenience, affordability, and trust. Customers are looking for platforms that are easy to use, provide access to high-quality goods / services, and offer transparent pricing and payment systems. Trust is also an important consideration, as customers need to feel confident that they are engaging in safe and secure transactions. Dynamics and market trends include ongoing innovation in technology and business models, increasing competition and consolidation, and evolving regulatory frameworks. The landscape of this market has been transformed by the introduction of services and platforms, including but not limited to peer-to-peer lending and co-working spaces. However, it has also faced challenges, including regulatory scrutiny and backlash from more traditional industries.

5.2.6 Competition and Rapid Growth in the Digital Video Market

The digital video market is a highly competitive and rapidly growing industry that has transformed the way people consume video content at large. It comprises various platforms that offer a wide range of video content, including user-generated videos / user generated content, TV shows, movies, and live events. The market is highly fragmented as well, with many players competing to capture market share, but a few key players dominate the industry today. The structure of the digital video market is characterized by a mix of subscription-based (SVOD), ad-supported models (AVOD), transactional (TVOD/EST), or free video on demand models (FVOD). SVOD platforms offer exclusive content and ad-free viewing, while AVOD platforms provide free access to video content in exchange for displaying ads. Some platforms also offer a hybrid model, where users can access some content for free and others through a paid subscription. TVOD refers to a model of video content distribution where viewers pay for each individual title they want to watch. In this model, the viewer is granted access to the content for a specifically defined period following the purchase. EST is a type of TVOD where viewers pay to own a digital copy of the content, which they can access at any time on the device of their choice. FVOD refers to video content that is made

available to viewers at no cost, often supported by advertising revenue or other sources of funding. Unlike TVOD, FVOD does not require viewers to pay for access to content.

The most significant players in the online video market include YouTube, Netflix, Amazon Prime Video, and Disney+. YouTube is the largest player in the market and has over 2b users (YouTube About, 2020), as well as and a vast library of UGC. Netflix is the leading SVOD platform, with a focus on original content production (Weinman, 2015: 197-210; Green, 2023). Amazon Prime Video is an add-on service to Amazon Prime, offering a mix of licensed and original content. Disney+ is a relatively new player in the market, offering a wide range of family-friendly content (Soares et al., 2022: 195-206). The market for online video has been experiencing significant growth. During the year 2020, mobile internet users worldwide consumed over 0.5t gigabytes of mobile data, with approximately two-thirds of that being used for streaming and downloading video content (Kemp, 2020). Half of the world's internet users, or 90% of online users aged 16-64, consume online videos monthly. Kemp (2020) also shows that SVOD is becoming increasingly popular, with five of the world's top ten non-game apps in terms of consumer spend being video apps in 2019. Of those, three (Tencent Video, iQiyi, and Youku) are primarily targeted at Chinese consumers. Among users aged 16-64 who watch TV content via streaming subscription services monthly, Mexico ranked highest with 88%, followed by Brazil (83%), Colombia (81%), Argentina (81%), the US (76%), Ireland (75%), Denmark (75%), South Africa (75%), and China (74%). While most consumption takes place at home, mobile devices have become the main space for access.

The most-used apps in 2019 on both Android and iOS that support video have been listed by Iqbal (2020c), with Facebook ranking at number 2, WeChat at 4, Instagram at 5, TikTok at 6, and QQ at 8. In terms of all-time downloads worldwide from 2010 to 2019, the following apps rank the highest according to Iqbal (2020c), citing data from App Annie: Facebook at number 1, Instagram at 4, Snapchat at 5, TikTok at 7, and YouTube at 9. With respect to usage figures in the United States, 49% of internet users aged 13 or above had used TikTok, compared to 67% for Snapchat, 74% for Instagram, and 90% for YouTube. In terms of daily engagement rates, TikTok follows Facebook, Instagram, YouTube, and Snapchat, with only 29% of monthly users being daily users. The percentage of US downloads of AVOD Apps among the top 100 Entertainment Apps in Q1 2019 is provided by SensorTower (2019) and is as follows: Tubi (35%), Pluto TV (30%), The CW (14%), Vudu (14%), and Sony Crackle (6%) (Briskman, 2019). The Business of Apps lists the most-used social platforms globally based on monthly active users, active user accounts, advertising audiences, or unique monthly visitors. The video-distributors are ranked as follows: Facebook (2.449m), YouTube (2.000m), Douyin/TikTok (800m), QQ (731m), Snapchat (382m), and Twitter (340m) (Iqbal, 2020c; Kemp, 2020).

The market for SVOD has undergone significant changes, with several new and prominent players now entering the field. These changes are set to reshape the television landscape, with services such as Disney+ (Soares et al., 2022: 195-206) and

Peacock by NBC Universal among these new players. Other players include Apple's TV+ and the broader expansion of Warner's HBO Max. According to Statista (2020e), the number of subscribers in 2020 was as follows: Netflix (186.53m), Disney+ (46.7m), Amazon Video (100.46m), HBO Max (17.4m), and Apple TV+ (1.86m). The report projects that these services will continue to increase significantly until 2025, with Statista predicting the following subscriber statistics: Netflix (258m), Disney+ (202m), Amazon Video (141m), HBO Max (25m), and Apple TV+ (14m) (Statista, 2020e).

According to Spangler (2022), in Q4 2021, YouTube's ad revenue as leader in the AVOD space reached $8.63b, surpassing Netflix's global revenue for the period. This is a 25.4% increase year over year, and the number does not include revenue from YouTube Music, YouTube Premium, or YouTube TV. YouTube Shorts, a new feature for creating and sharing short-form videos on the platform, has delivered over 5t views since its launch in September 2020. The format has gained popularity among users, with over 15b daily views and 1.5b monthly active users reported in December 2021. YouTube has also announced monetization opportunities for creators through branded content and shopping deals. However, the success of Shorts may vary by region and content type (Spangler, 2022). As of 2020, YouTube had over 2b logged-in users who visit the site each month, watching over 1b hours of video daily and generating billions of views. 70% of these views come from mobile devices, indicating that the platform is predominantly accessed via mobile. YouTube is available in 100 countries and 80 different languages, and it invests heavily in creators, resulting in significant growth year over year. YouTube invested over $2b to support its partners that monetize their claims using Content ID, a system that supports over 9k premium content partners such as TV networks, broadcasters, movie studios, and record labels. As a result of this investment, the growth of channels generating an annual income of six figures has increased by 40%, while channels generating five figures have increased by 50%, and channels with over one million subscribers have increased by 65% (YouTube About, 2020).

While YouTube has the largest user base of any platform in the AVOD space, with over 2b users according to YouTube About (2020), it's important to note that this diversity doesn't necessarily translate to the platform's user base, as it was revealed that 24% of content creators were responsible for 71% of the views on YouTube. A similar trend was observed on Facebook, with 26% of producers generating 77% of views. The companies with the highest number of views at the time of the report were Buzzfeed (4.2b on Facebook, and 703m on YouTube), LadBible (4.2m on Facebook, and 2.3m on YouTube), UniLad (4m on Facebook, and 2.7m on YouTube), JungleCreations (4m on Facebook, and 9m on YouTube), and TimeWarner (1.9 m on Facebook, and 1.3m on YouTube) (Turbular, 2018). Currently, people watch over 1b hours of video on YouTube each day, with the platform having 45% female users and 55% male users. The most-searched queries were related to music and video games, such as ‘song’, ‘songs’, ‘video’, ‘baby’, ‘music’, ‘karaoke’, ‘musica’, ‘new song’, ‘Fortnite’, ‘Minecraft’, and ‘Story’. The most-viewed YouTube videos of all time were music videos, including Luis Fonsi ft. Daddy Yankee’s Despacito with 6.59b views, followed by Ed

Sheeran's Shape of You (4.55b), and Whiz Khalifa ft. Charlie Puth's See You Again (4.35b). The most viewed videos on YouTube are all music videos, according to the data. T-Series is the most subscribed channel with 123m subscribers, followed by PewDiePie (102m). Other popular channels include Cocomelon (69.3m), 5-minute crafts (63.3m), SET India (62.4m), Canal Kondzilla (54.5m), WWE (52.9m), Zee Music Company (48.5m), Dude Perfect (48.2m), and Justin Bieber (48.1m) (all data points sourced from Kemp, 2020).

Customer needs in the digital video market include easy access to high-quality video content, personalized recommendations, affordable pricing, and a seamless viewing experience across devices. Within social video apps such as TikTok, users can interact with others while watching videos through features like comments, reactions, and sharing, which encourages community engagement and social interactions around video content. Creators can live stream events, such as concerts and sports games on e.g., TikTok Live, which includes the ability to interact with viewers in real-time. Users can also host virtual watch parties with friends in e.g., Facebook, where they can watch videos together and chat. Creators can monetize their content through ads, which appear before, during, or after a video (pre-, mid-, or post-rolls). Platforms that can effectively meet these user needs and provide high-quality content and user experience are likely to be successful. Video services are designed to provide users with a personalized social video experience (Wang et al, 2016) that encourages engagement and community building. By combining personalized algorithmic recommendations with original content and social interactions, digital platforms aim to create a unique video streaming platform that stands out from competitors, as video has become a highly popular medium, and given that there is significant demand for high-quality content. As such, the market trends in the online video market are dynamic, the COVID-19 pandemic has further accelerated the shift towards online video consumption, with more people working from home and spending more time indoors. Platforms are investing heavily in original content production and licensing agreements with content creators to capture market share. Additionally, new technologies such as 5G and AR are expected to transform the online video market in the coming years, providing new opportunities for growth and innovation.

5.2.7 The Digital Audio Market Nearing the Peak of the Streaming Age

The digital audio market comprises a diverse array of products / services that enable users to access and listen to various types of audio content, such as music, podcasts, audiobooks, and more. This market has grown rapidly in recent years, with the increasing popularity of streaming services and the widespread availability of high-quality mobile devices. The structure of the digital audio market is complex, with a range of players operating in different segments of the market. On one side of the spectrum are music labels and other content creators who create and authorize audio content for subsequent distribution. In the middle of the market, there are streaming services like Spotify, Apple Music, and Amazon Music, which offer consumers access

to a vast library of digital audio content. Finally, at the consumer end of the market, there are a range of devices and apps that allow users to listen to digital audio content, such as smartphones, smart speakers, and headphones. In terms of competition, the digital audio market is highly competitive, with many differing players vying for market share. The major players in the streaming segment of the market are the mentioned services as well as a larger number of smaller, niche players that cater to specific audiences or genres of music.

The audio industry has undergone a significant transformation with the rise of digital, akin to the changes witnessed in the video domain. According to the International Federation of the Phonographic Industry (2019), global recorded music revenues experienced an increase of 9.7% in 2018, resulting in total revenues of $19.1b. The report indicated that streaming revenue represented 46.8% of the global total revenue, almost half of all revenue, fueled by a 32.9% increase in paid subscription streaming, also noting a decline in physical revenues of 10.1% and in download revenue of 21.2%. At the end of 2018, 255m users paid for streaming services, accounting for 37% of total recorded music revenue. As such, unlike the 2000s, where the prevalent model was downloading music, in recent years, streaming has taken over the audio industry, with the number of paid subscribers to music streaming services worldwide exceeding 400m in 2020 (IFPI, 2020), up from around 100m (Digital Music News, 2017). Revenue from digital music streaming also increased significantly over the same period, with the market expected to be worth more than $20b by 2025 (Technavio, 2021). In 2022, the global music market experienced a 9.0% growth in revenue (reaching $26.2b), with streaming continuing to be dominant, accounting for 67% of global revenue, up from a 65.5% share the previous year. Subscription-based streaming services, such as Spotify and Apple Music, saw a growth of 10.3% in revenue (to $12.7b), while revenue from audio streams, including both subscription-based and ad-supported services, saw a growth of 9.0% (International Federation of the Phonographic Industry, 2023). Growth came from a variety of revenue sources, including streaming, physical, performance rights, and synchronization, with only downloads and other digital sources seeing a decline. Overall streaming revenues grew by 11.5%. The number of paid subscriptions reached 589m.

In the second quarter of 2022, Spotify had the largest subscriber share of music streaming services worldwide, at 30.5%, followed by Apple Music (13.7), Tencent Music (13.4%) and Amazon Music (13.3%). Other streaming services had a combined subscriber share of 29.1%, including YouTube Music with 8.9% subscriber share, and Netease with a 6.1% (Statista, 2022c). While the increase in streaming revenue compensated for the decrease in revenue from physical sales and downloads, it is crucial to also consider as well overall streaming audio consumption, not just premium subscriptions. The International Federation of the Phonographic Industry (2023: 14-15) provides an overview of the global recorded music market in 2022, with Asia experiencing the highest growth rate (15.4%), and with MENA posting the world's third-highest growth rate (23.8%), while Sub-Saharan Africa became the fastest-growing region

with a steep increase of 34.7%. USA and Canada maintained its foothold as the world's largest region for recorded music, with revenues increasing by 5.0% in 2022 (41.6% of the total global market). Both the USA (up 4.8%) and Canada (up 8.1%) remained global top 10 markets. Asia saw double-digit growth for the third consecutive year, up by 15.4% (22.9% of the global market), Japan experienced a second year of consecutive growth (up 5.4%), while Latin America revenue rose by 25.9%, with every market seeing double-digit growth. In 2022, revenue increased in every region and in each of the world's top 10 markets, with China (up 28.4%), entering the top five for the first time and Brazil re-entering the top 10 (International Federation of the Phonographic Industry, 2023). YouTube remains the main player in the audio streaming industry, with its enormous user base of 2b users (YouTube About, 2020).

Regarding customer preferences, the digital audio industry is influenced by a variety of differing aspects, such as the ease of use, the availability of diverse content, and the ability to listen while on the move. Moreover, customers are progressively interested in top-notch audio experiences, with many willing to pay extra for high-resolution streaming or superior headphones and speakers. As for market developments, several factors are shaping the digital audio domain. One key trend is the continued growth of streaming services, with more and more consumers opting to pay for access to a vast library of digital audio content rather than purchasing individual tracks or albums. Another trend is the increasing focus on high-fidelity audio experiences, with a growing number of companies investing in technologies like immersive sound and spatial audio. Finally, there is a growing trend towards personalized and curated audio experiences, with streaming services using ML/AI and other technologies to recommend content to users based on their listening habits and preferences.

5.2.8 Demand for AI-Enabled Products Driving the Market for Artificial Intelligence

The AI market has experienced significant growth in recent years (cf. Galloway, 2017: 196-200) and is projected to continue expanding in the foreseeable future. The market is segmented into different categories based on technology, application, and geography. The primary drivers of the AI market include increasing demand for AI-enabled products / services, rising adoption of cloud-based services, and growing investment in AI technology. The competitive landscape of the AI market is diverse, with established players and startups competing to capture market share. Some of the key players in the AI market include Google, Amazon, IBM, Microsoft, Intel, and Apple, among others. These companies offer a wide range of AI solutions, including natural language processing (NLP, cf. IBM, n.d.c), computer vision, robotics, and ML.

Various trends and investments can be observed in the AI space. There has been a significant increase in investment in AI startups, in areas such as ones listed but companies are also increasingly investing in AI infrastructure to build scalable AI systems and improve speed and efficiency of AI processing (Tracxn, 2022). Alphabet’s

GV, for example, invests in startups in various fields of the technology industry, including AI and cybersecurity (CNBC, 2018), while its property DeepMind Technologies provides advanced AI technology with deep learning and reinforcement learning algorithms (TechCruch, 2014). Companies further invest in AI talent to develop in-house AI capabilities and attract top AI talent from academia and other industries (World Economic Forum, 2023); while large partnerships are being formed to acquire AI startups that provide new AI technology, and talent (cf. Tracxn, 2022). Some notable AI startups acquired by Google include companies such as Wavii, Timeful, Moodstocks, Halli Labs, Kaggle, AIMatter, or Vision Factory (Crunchbase, 2020), enabling the company to expand AI capabilities and enhance its offerings. There has been interest in investing in ethical AI, too, with a focus on developing AI that is transparent, accountable, and aligned with human values (Digital McKinsey, 2019: 40).

As several companies lead the field of AI, there is a clear centralization of AI R&D in certain geographical areas. The sector is mainly divided between the US and China, with the former being home to big tech like Alphabet, Amazon, Meta, IBM, and Microsoft (with its property OpenAI, cf. The Verge, 2023), and the latter to Baidu and Alibaba (Digital McKinsey, 2019: 31). In addition to these companies, there is a second group that includes American companies Oracle and Salesforce (Digital McKinsey, 2019: 30), as well as Germany's SAP. Alphabet has played a significant role in advancing the field of AI, having made substantial contributions to its development. In addition, the company has introduced its own cloud-based AI platform, called TensorFlow. Microsoft has extended the partnership with OpenAI (The Verge, 2023) and introduced the Azure platform (Janakiraman, 2020), while Amazon has acquired AI startups and is utilizing AI in e-commerce, supply chain management, and customer service to improve efficiency and the customer experience (Crunchbase, n.d.). Meta is using AI for image and video recognition, NLP (IBM, n.d.c), and personalized recommendations (cf. Adebayo, 2022 in relation to AI impact on the metaverse). IBM is also contributing to the development of Watson, its flagship AI platform (IBM, 2021). Baidu, a Chinese company, is using AI in areas such as autonomous driving, speech recognition, and NLP (Baidu, n.d.). A notable feature of the Google Cloud Platform is AI applications (Google Cloud, n.d.c), which include support for hiring, analysis of unstructured texts and images, conversion of voice to text and vice versa, automated translation, personalized insights and predictions of customer behavior, creation of custom applications, and solutions in deep learning. While the most open segments for AI are technology, telecommunications, automotive, and finance, new players are frequently emerging in the field. The technology sector is dominated by major platforms that invest heavily in R&D. Vehicle manufacturers have also been investing in automation for many years (cf. Shrivastava et al., 2019: 410-413), while the financial industry increasingly relies on algorithms and intelligent systems for stock trading.

Customer needs in the AI market are diverse, ranging from improving operational efficiency to developing new business models and creating personalized customer experiences. AI is utilized to automate workflows, enhance decision-making capabilities,

and reveal novel insights. The dynamics of the AI market are fast paced, with new services, technologies and applications emerging at a rapid speed. One of the trends in the AI market is the growing focus on explainable AI (cf. Vilone/Longo, 2020, which aims to make AI systems more transparent and accountable. Another trend is the increasing use of AI for NLP (cf. Yuan/Gao, 2021). In terms of market trends, the AI market is projected to continue growing, driven by increasing investment and adoption of AI technologies across industries, and anticipated to be highly lucrative in the foreseeable future, with most of the expansion driven by ML and deep learning. Other trends include the rise of edge computing (Cao et al., 2020), the increasing use of AI in cybersecurity (cf. Das/Sandhane, 2021), and the adoption of AI-powered chatbots and virtual assistants (Agarwal et al., 2022; Adamopoulou/Moussiades, 2020).

5.2.9 AR and VR Advances and Metaverse Entry Points Driven by Gaming and Entertainment

The AR/VR and metaverse markets are very uncertain and dynamic but offer potential for businesses across various industries. The market for AR/VR technology is primarily driven by the gaming and entertainment industries, while the metaverse market focuses on creating shared virtual spaces where people can interact in real-time, using avatars. The competitive landscape for AR/VR is dominated by companies such as Meta (Oculus), HTC (Vive), and Sony (PlayStation VR), while the metaverse market is still emerging with companies such as Roblox, Fortnite (Epic Games 2021a; cf. Ball, 2019; Balis, 2022), and Second Life leading the way, as well as startups like Decentraland or Somnium Space. These enterprises are allocating substantial resources to the R&D of technology, as well as hardware and software, with the goal of enhancing the user experience and broadening their range of services.

The pandemic accelerated the development of the metaverse (Schmidt/Banusch, 2022), the metaverse can open new sources of income and creative potential for companies (cf. Bobier et al., 2022, Feifei, 2021). Meta is accelerating this concept, directing its corporate strategy towards the metaverse with a $10b investment in its Reality Labs division (which recorded a net loss of $13.7b in 2022, according to CNBC, 2023), Microsoft betting $70b on a future in the metaverse with its acquisition of Activision Blizzard, venture capital funds invested US$25b in 2021 (Bobier et al., 2022). Virtual world revenue may reach $400b by 2025 (Grayscale Research, 2021; Bobier et al., 2022), the metaverse offers a $1t annual revenue opportunity in advertising, digital events, e-commerce, and hardware (Robertson, 2021). The global AR market was valued at $17.67b, following stats provided by Grand View Research (2021). This market is set to grow at a CAGR of 43.3% from 2021 to 2028, rising to US$340b by 2028 (Emergen Research, 2022). As an illustration, Spark AR happens to be an AR-based platform that empowers software developers to craft augmented reality effects for usage on Facebook and Instagram. These AR effects, which comprise diverse filters, animations, and visual effects, can be applied to both pictures and videos (World of VR, n.d.).

Increasing demand for remote work and collaboration from companies that help manage and streamline workflows are driving growth (Grand View Research, 2021). AR is becoming more integrated (Accenture Technology Vision, 2022) and may become central as basis for communication and consumption habits in the metaverse (cf. Bobier et al., 2022).

Companies have already made virtual worlds their own (Iddenden, 2021), users shop immersively (cf. Deloitte, 2022; National Research Group, 2021), opportunities for cooperation arise and branding and advertising can be placed (Kantar, 2021; Iddenden, 2021). The Google Glass represented a first step towards a metaverse (Iddenden, 2021), but initially failed due to social (such as privacy and design concerns) and technological factors (such as a limited functionality). Snapchat followed up with Spectacles (Iddenden, 2021), glasses that integrate real-time overlays into your vision, as does Microsoft's HoloLens. AR glasses from Apple and Huawei are under development (Goode, 2021). VR glasses capture a fully digital environment accessed through closed headsets (e.g., Oculus Quest 2) that allow users to explore and interact in digital worlds (Goode, 2021). Oculus is Meta's VR platform, which includes both hardware and software. The Oculus VR headsets allow users to experience VR environments, while the Oculus software includes a variety of VR apps and games - both assets driving helped innovation in the VR industry. Horizon Workrooms is a VR app designed for remote collaboration, allowing users to meet and work together in a virtual environment, using avatars to represent themselves. The Pokémon Go game allowed the ingame world to be projected onto the real one, Ikea enabled potential purchases to be projected into one's own house using an app (Hamari et al., 2018: 804-819). As a more immersive successor to the mobile internet (cf. Accenture Technology Vision, 2022), and powered by enhanced AR/VR and wearables, the metaverse can become part of the future of commerce (Forkast, 2021; Bobier et al., 2022). New target groups and behaviors result in research opportunities regarding shopping, product tests, and advertising formats (Kantar, 2021; Balis, 2022). Meta's decision to reorient its business towards the creation of the metaverse was largely driven by the company's recognition of the concepts' potential. In 2021, the company announced its intention to rebrand itself as Meta and focus on building the metaverse (Meta, 2021). This shift in focus was motivated by the belief that the metaverse will become the next major computing platform, surpassing the mobile internet, social media, and even the web itself in terms of importance and potential impact. The company sees it as a new frontier for social interaction, entertainment, and commerce, believes that it has the resources and expertise to lead the way in its development, and has announced partnerships with companies to support the metaverse development, including game developers, media companies, and tech companies (AI Business, 2022).

The enthusiasm for smartphones, smart glasses, and other handheld and wearable devices is driving the adoption of mobile AR technology to deliver immersive experiences. The US entertainment groups Disney and Snapchat have already realized an AR-supported Disney theme park metaverse (Southard, 2021). Businesses are using

AR-based apps to deliver an interactive experience and are driving an immersive retail landscape, from Pinterest's AR Try-On tool to Snapchat's acquisition of 3D and AR platform Vertebrae, with which brands can create virtual items for purchase on Snapchat. 70% of consumers say they want to see more AR ads, almost 75% say they are more likely to pay attention to AR ads (Grand View Research, 2021). Of the 1.5b AR users worldwide, 100m use AR for shopping, while 74% of consumers expect AR to become more important in their lives in the next five years (Snapchat, 2021). By 2025, 75% of the world's population is projected to be frequent AR users. Mobile AR marketing today delivers significant measures, e.g., Barclaycard collaborated with singer Anne-Marie for a global AR OOH spot (Visualise, 2021). AR billboards showed the artists' digital twin providing information about the sponsored live music events. The campaign included a billboard volumetric (3D) experience featuring the singer-songwriter and another experience allowing viewers to see the performance in their own homes. The IoDF and MACHINE-A created an AR store during London Fashion Week that was advertised on billboards and brought the clothes to life via scannable QR codes (Showstudio, 2021). Other examples can be found in virtual advertising spaces in stores. Brookfield Properties and media brand The Aria Network offered virtual AR advertising assets to stores in 100 of their malls (PSFK, 2021).

As real-life moments are transferred to the digital world, Fortnite and Roblox are focal points for online experiences (Bobier et al., 2022; Wilson 2021). 2.7b gamers (Corry, 2021; Wootton, 2021c) use these platforms, brands are also active. Ball (2019) affirms that these platforms can be actual points of entry into the metaverse. Companies are building metaverse teams to be future-proof (Chitrakorn, 2021), brands are experimenting with new technology (Radoff, 2021) and acquiring customers on these platforms (Deloitte, 2022; Southern, 2021). Gaming features (such as engagement, interactivity) are not only used for marketing or entertainment, but also for product education and design (Thompson Intelligence, 2021).

Fortnite is a worldwide popular multiplayer game that can be played on Windows, Mac, Xbox, Playstation and mobile phones (Ball, 2019). Fortnite did not see the largest increase in unique users (10.7m) during regular games, but during DJ Marshmello's live concert (Zak, 2019; Ball 2020). Users experienced the event in real-time, but there were 100k slightly asynchronous instances of the concert (100 gamers per instance) (cf. Ball, 2020). Fortnite sees itself as more than just a game (Herrman / Browning, 2021; Thompson Intelligence, 2021), the platform has presented its own vision of the metaverse (Epic Games, 2021a) and has corresponding elements (Ball, 2020; 2019): it mixes IP, provides a consistent identity across multiple platforms, is a gateway to diverse sometimes purely social experiences, and compensates for content creation (Ball, 2019). Fortnite hosted in-game concerts, the O2 Arena (Epic Games, 2021b; Wilson 2021), a Super Bowl stadium (Bobier et al., 2022) and in-game outfits were prereleased (NBA, 2021). The latter partnership (NBA, 2021) included Locker Bundles, available in the Item Shop, containing a collection of items favored by NBA stars or

Fortnite players. There were also NBA team battles for which players could register (Epic Games, 2021c; Tassi, 2021).

Roblox has been active since 2006 and achieved mass success in 2020, resulting in its 2021 IPO with a valuation of $45b (Orland, 2021). More than half of the user base of Roblox is comprised of children under the age of 13, while the age group of 17-24 is currently the most rapidly expanding demographic on the platform, with close to 50% of the group being female. In 2020, more than 30b hours were already spent gaining experiences on Roblox (Southern, 2021), over 50m active users and 8m developers in 180 countries used Roblox daily by the end of 2021 (Roblox, 2022), more than 42m users log in every day and play 10b h and 652min. US dollars were implemented in the form of the in-app currency Robux (Bobier et al., 2022) with virtual objects and clothing for avatars (Herrmann / Browning, 2021). The game is free to play, users can exchange US dollars for Robux, and creators get a percentage share. Brands build Roblox experiences (Southern, 2021; Thompson Intelligence, 2021; Wilson 2021), the platform called itself a metaverse (Lipscombe, 2022), which offers experiences. This term, according to the company, is consistent with how Roblox has developed its terminology to reflect the current realization of the metaverse. The platform refers to these worlds as experiences as this terminology better represents the wide range of immersive 3D places, from obbys (obstacle courses) to virtual concerts, as people come together in the metaverse (Luby, 2021). Artist Lil Nas X reached 33m users with an in-game concert in 2020 (Roblox, 2020), Zara Larsson hosted a launch party. Musical performances in the Metaverse on Roblox are already a mix of real and virtual moments with engagement opportunities (Parmenter, 2021). Gucci hosted its Archetypes Gucci Garden on Roblox (Roblox, 2021a; Thompson Intelligence, 2021) and launched various goods on the platform, including a virtual version of a bag, which was not NFT and had no value outside of Roblox. This nonetheless sold for $6 before being resold for $4,115, about $800 more than its physical version (Kelly, 2021). Netflix initiated the Starcourt Mall Experience (Porter, 2021). The virtual mall acts as an environment reimagined within Roblox, opening new opportunities to engage and grow the series' global audience. Here, according to Wootton (2021a), the platform functions as the new social meeting place, like the local mall in the 1980s where the teenagers on the show used to gather. PacSun, in turn, presented branded items and, with the help of Melon, a company focused on building metaverse experiences, also designed brand worlds within Roblox (Pacsun, 2021). Customers can use their virtual Robux to create new stores and improve established ones, make the mall more attractive to customers, and invite friends. Warner Bros. promoted the movie Washington Heights (Roblox, 2021b) by replicating an NYC area that included an in-platform viewing party of a clip from the film, and a Q&A with the cast, games, and virtual goods (Wootton, 2021b).

Customers are seeking immersive and interactive experiences through AR/VR technology and metaverse platforms. As demonstrated, gaming and entertainment are the primary use cases for AR/VR, but the technology is increasingly being used in

education, healthcare, and retail. In the metaverse market, customers are seeking social interaction, entertainment, and the ability to conduct business in virtual environments. The dynamics and market trends in these markets are heavily influenced by advancements in technology, the increasing adoption of 5G networks, and the growth of the gaming and entertainment overall. The COVID-19 pandemic has also accelerated the adoption of AR/VR and metaverse platforms as more people are seeking virtual alternatives to physical interactions. Challenges in these markets include the need for improved hardware and software capabilities, privacy, and security concerns, and the potential for monopolistic practices by dominant players. Governments and regulatory bodies are also paying attention to these markets and considering potential regulations to ensure fair competition and protect consumer rights.

5.3 Market Dynamics, Mechanisms, and Effects Inherent to the Digital Platform Economy

5.3.1 Observing Dominant Platforms and Large Market Shares Across Digital Platform Markets

The digital platform economy is a rapidly growing and evolving area of the economy that has brought with it many benefits and challenges. The general market overview provided in chapter 5.2 illustrates the various markets within the digital platform economy and highlights the trends and factors shaping these markets, and one of the most prominent issues in this space is the concentration of power in the form of large market shares among a small number of dominant platforms. The concentration of power in the multi-sided digital platform economy is often driven by network effects, which occur when the value of a platform increases as more users join it. The existence of this feedback loop can create a positive cycle that results in one dominant platform capturing the largest share of the market, leading to a winner-takes-all scenario. In the digital platform economy, dominant companies specialize in specific segments or niche markets forming digital ecosystems. These include e.g., Microsoft's OS, Alphabet's search engine, Meta's social networks, or Amazon's e-commerce platform. Although Apple's market share is not the largest in in any of its segments, its global weight and market valuation still give it a strong influence. The dominance of these companies enables them to generate revenue and obtain essential inputs such as personal data managed by e.g., Alphabet, software controlled by e.g., Microsoft, and a vast register of buyers from Amazon, to stick with the examples.

The dominance reflects in terms of financial performance. By way of example, over the course of ten years, Alphabet's total annual revenues increased by more than six-fold, as between 2009 and 2019, the revenue of the digital platform economy grew from $23.7b to $160.74b, indicating a staggering cumulative increase of 678%, or nearly seven-fold. This translates to an average annual growth rate of 67.82% (Statista, 2020f). There was a notable and consistent increase in the positive results of the

company over time, as shown by the following annual figures (Statista, 2020b). Alphabet outperformed expectations for the Q4 2021, reporting $75.33b in revenue, an increase of 32% YoY, and a net income of $20.64b, or $30.69 per share, representing a 36% YoY growth (Spangler, 2022). The revenue rose from $90.3b in 2016 to $182.5b in 2020, while the net income increased from $19.5b in 2016 to $40.3b in 2020. The company has also maintained a strong balance sheet, holding significant cash reserves, and a relatively low level of debt. For comparison, from 2009 to 2021, Meta's total revenue grew from $777m to $117.929b, marking a growth of over 151 times (15177%). The year-over-year growth of 37% in 2021 resulted in a total revenue of $85.965b. The composition of advertising revenues grew from 85% in 2011 to 97.46% in 2021 (Culliford/Balu, 2022). Meta has experienced a substantial increase in its advertiser base over the past few years, with the number of advertisers growing more than two-fold from 3m in 2016 to 10m in 2020, according to Statista (2022b). Accordingly, the most popular brands on digital social networks tend to be large companies: GoPro (which shows a total of 16.2m Instagram followers, 2.23m Twitter followers, over 10.7m Facebook followers, and a widely used hashtag with #GoPro), Nike (93.3m Instagram followers, 7.95m Twitter followers, 33.3m Facebook followers), Spotify, Wayfair, Pop-Tarts, National Geographic, Starbucks, Dove (Salamander, 2022).

Dominant platforms are also characterized by having a large user base, ranging from hundreds of millions to billions of users, as has become clear by reviewing digital platform markets in detail. YouTube has 2b customers (YouTube About, 2020), while Meta's platforms (Facebook, WhatsApp, Instagram, Messenger) have billions of users, and aggregate 54.64% of the total user base in the top 10 largest digital social networks globally. Tencent is the runner-up, with 13.26% of profiles in the top 10. Meta has 2.910b users on Facebook, 2.0b on WhatsApp, 1.478b on Instagram, and 988m on Messenger (Statista, 2022a). Amazon has 300m active users (Petrov, 2020), and Apple has a consumer base of 1.4b (Lee, 2019). Chinese platforms such as Tencent and Alibaba have massive user bases, with more than 1.17b monthly active users on WeChat (Iqbal, 2020b), over 617m monthly mobile users and more than 552m active users on its China retail marketplaces (TMall and Taobao), while competitor JD.com has more than 292m customers (Laubscher, 2018). Meanwhile, Google accumulates more than a total amount of 1.6b Android users out of the 3.5b smartphone users worldwide (Statista, 2020f).

The global reach of digital platforms is another important aspect to consider. While some platforms like Amazon have taken longer to expand internationally (Galloway, 2017: 13-62, 190-191), others such as Meta and Alphabet have achieved a worldwide presence. Selling platforms like Amazon, Apple, and Microsoft face more complex challenges when expanding globally, but they have still been successful in doing so. Apple, for instance, has opened more than 510 stores in 25 countries and regions since 2001 (MacRumors 2020). Language is an important factor for services offered directly on the Internet, such as Facebook (available in over 111 languages, cf. Fich/Dave, 2019), and Google, which has registered 274 domains in 199 different countries (IPFS,

2020). Based on the volume of users and secondary sources, it appears that Meta has the most extensive global reach (cf. Galloway, 2017: 111). Taking March 31, 2021, as a reference, 54.9% of users came from Asia, 8.4% from Latin America, 10.6% from Europe, 4.7% from North America, 17.4% from Africa, 3.4% from Middle East, and 0.6% from Oceania/Australia (available at: www.internetworldstats.com). In a survey (World Map of Social Networks, available at: vincos.it/world-map-of-social-networks) in relation to popularity of digital social networks in each country, Facebook ranked as the network with the widest spread of usage in 156 out of the total amount of 167 countries (93%). Only China and Russia are dominated by local digital social networks (WeChat/Weixin and VK).

Dominant platforms have the capability to diversify into other segments outside of their original niche, setting them apart from other players. This diversification is implemented efficiently and rapidly by companies like e.g., Microsoft, Amazon, and Apple. Microsoft (Galloway, 2017: 222-225) expanded into electronic gaming, smart lenses, computers, and services such as the Azure AI-based development platform or the Intune management platform. Amazon sells a wide range of products, has an employment agency platform, entered the food market, and launched automated convenience stores. Apple acquired Beats, a company that produces headphones, to enter the audiovisual content production segment, and Apple Pay to enter the payment method market.

Dominant platforms rely heavily on data collected from users, using it to anticipate demands and personalize recommendations. The control and analysis of large databases give platforms a competitive advantage, allowing them to predict and modulate user behavior, which in turn provides power over customers. The ability to make personalized recommendations based on user data is crucial to platform success, enabling the launch of new services in line with user preferences. Digital platforms play a crucial role in facilitating communications, interactions, and transactions within ecosystems of services. By controlling these interactions, they determine the relationships within the ecosystem. For instance, Microsoft pre-installed software on the Windows OS, and Google's and Apple's app store control interactions between producers and consumers of mobile apps. Similarly, platforms like Amazon Video and YouTube impose rules for interactions between producers and consumers of content. Another crucial aspect of dominant platforms are the M&A strategies in relation to competitors or market participants. These involve M&A in various markets, different stages of the production chain, or same or different product lines, as part of a diversification strategy.

As such, to succeed, digital ecosystems rely on their technology, integrated services, and scalable use of data. Economic factors also play a key role, with companies positioning themselves strategically to introduce new solutions and systems. As these ecosystems expand into new segments and sectors, they encounter new challenges. The expansion of their business is propelled by positive feedback loops, advantages gained from increasing scale and scope of operations, and the benefits of cost efficiency. Capacity restrictions and user needs may slow down concentration tendencies,

meaning that traditional market power factors (e.g., market share) may not be enough to determine market power in the digital platform economy.

5.3.2 Multi-Sided Markets, Groups of Users and Competing Interests

Comprehending the dynamics of multi-sided markets is vital while scrutinizing the influence of technology on the digital platform economy, given that digital platforms frequently operate in multi-sided markets, where they serve the requirements of numerous user groups, including purchasers and suppliers, advertisers and users, or developers and individual users. Two-Sided Markets can be defined abstractly as markets in which one or more platforms connect two customer groups with each other and have both sides paid for this service in some form (Evans/Schmalensee, 2007; Rochet/Tirole, 2006: 645-667). The interactions between these groups of users create network effects that drive platform growth and value creation. A multi-sided market structure is comparable to a double-sided platform (Rochet/Tirole, 2006: 645-667), which serves as a conduit for linking multiple groups of users together. This platform can leverage network effects by enticing additional users from both sides of the market, resulting in a self-reinforcing feedback loop that strengthens the platform's competitive advantage. For example, more sellers on an e-commerce platform can attract more buyers, which, in turn, can attract even more sellers. Understanding the different user groups and their interactions is crucial when analyzing the impact of technology on the digital platform economy. Policymakers have a responsibility to recognize the potential downsides of market dominance and to prioritize promoting competition in multi-sided marketplaces. Similarly, enterprises must grasp the intricacies of these markets to devise schemes that capitalize on network effects and generate benefits for all the different parties involved.

In the realm of digital markets, it is innovation that serves as a key driver of competition, rather than exact delineations of markets or knowledge of the percentage of market shares held by different entities. Nonetheless, it is still important to understand competitive relationships. It is unclear which relationships should be included in a competitive analysis, especially when there are independent market relationships that do not involve payments. To examine these issues comprehensively, the concept of multi-sided marketplaces is used. In conventional markets, the suppliers concentrate on customers, and the interaction between them establishes the price of a product / service, a viewpoint is presented in a study by Rochet/Tirole (2003: 990). The concentration and power of the market depend on networking, scaling effects, and prospect of entering a market. The concept of two-sided markets has become increasingly significant in more recent years, especially regarding both conventional and sizable online platforms. These markets involve connections between different sides of supply and demand, which is ideal for sectors with fluctuating demand and supply, reduced ability to connect, and deficient supply optimization. This type of market is called multisided markets, where companies offer connections between different sides. Pricing structures are defined for both sides, and cross-subsidy between them is common. The

platform plays a central role in mediating transactions, and concurrent consumption (e.g., multi-homing, cf. Evans et al., 2016) on the buyer side can drive a more favorable price structure for the seller side. Platforms design prices to bring both sides on board, and the structure of pricing, not just price alone, contributes to profits.

Two-sided markets exist in various forms (Gawer/Cusumano, 2008: 28-35), including dating platforms, credit cards, PCs, and auctions, all sharing a triangular relationship. In the digital platform industry, two-sided markets are especially relevant and are gradually replacing traditional one-sided markets (Rochet/Tirole, 2006: 645-667). Digital platforms are products, services, or technologies that enable companies to offer complementary products, services, and technologies, serving two or more sides and facilitating direct interactions between them, allowing them to find each other easily. The platforms act as intermediaries and enable interactions to take place without involving themselves. In contrast, retailers have a more straightforward transaction process where they buy goods from suppliers and sell them to end consumers. However, this process is not considered a two-sided market as retailers control critical transaction variables such as price. One approach to defining a two-sided market is by examining the external effects between the platform's different sides. A one-sided market need not be the direct opposite of a two-sided market and may exist on a continuum (cf. Rochet/Tirole, 2006: 645-667).

Digital platforms allow diverse actors to connect beyond geographical and temporal barriers (Galloway, 2017: 202-203), bringing significant changes to various industries through data-driven and disruptive business models. In some sectors, software platforms have become central to entire value chains, occupying positions between traditional providers and customers. The unique characteristics of market dynamics within digital platforms differentiate them from traditional analog markets. Platforms create value by connecting providers and buyers via an internet-based software system that offers services such as web shops, rating systems, and payment systems, minimizing transaction costs and streamlining service exchange. The platform operator sets the rules and earns revenue from each exchange and by monetizing user data (cf. Parker et al., 2017). To that extent platform-based business models differ from traditional approaches by not relying on traditional means of production, instead focusing on bringing together customer groups for business purposes.

The users on the platform are the means of production for these companies. Platform companies aim to facilitate interactions and transactions on their platforms, instead of producing a product or service to meet market demand. They function as the marketplace, linking multiple sides of the market, such as suppliers and customers. Marketplaces in the digital economy have unique market mechanisms and interaction patterns (Parker et al., 2016). According to Parker et al. (2016), networked markets refer to platforms that bring together various groups of customers and producers. These markets differ from traditional markets and create new business opportunities. Although online platforms provide different services, they tend to share similar characteristics and can be classified into different business model areas. Not all platforms

conform to the theoretical definition of a platform and differentiating them from companies that offer their own goods or services can be difficult since both types of companies link user groups, gather data, and conduct data analysis. It is also essential to consider that multi-sided platforms are more widespread than usually recognized, and regulations should not restrict business models.

One of the key impacts of multi-sided markets is in online advertising. Platforms such as Microsoft, Meta, and Twitter bring together advertisers and users, and allow advertisers to target their messages to specific audiences based on user data, thus revolutionizing the advertising industry, and leading to a significant shift in advertising spending away from traditional media such as print and television. Another impact of multi-sided markets is in e-commerce. Platforms such as Amazon and eBay bring together buyers and sellers, and facilitate transactions (cf. Galloway, 2017: 13-62) amongst them, facilitated a substantial surge in online sales by small-scale businesses and individuals, offering entrepreneurs new prospects to extend their reach beyond borders. Besides, these markets have also brought a transformation in content creation and distribution. Platforms such as YouTube and Twitch bring together content creators and users, and allow creators to monetize their content through advertising, sponsorships, and donations. As a result, novel forms of media have emerged, including live streaming of video games and influencer-based marketing, providing novel avenues for creative individuals to generate income.

Despite the benefits of platforms, there is a concern that their growing dominance could result in the suppression of competition, constraining users' options, and leveraging their market influence to extract profits from suppliers and users. Multi-sided markets in the digital platform economy are particularly relevant in this context, as they involve multiple groups of users with potentially competing interests. CTT argues that these markets can reinforce existing power imbalances and create new ones, highlighting the importance of examining these power dynamics and the interests of different groups of users. For example, platforms may prioritize the interests of advertisers over those of consumers or may use data collection to reinforce existing imbalances. In addition, the design of the platform itself can shape power dynamics of the market, e.g., through algorithms that determine search results or product recommendations.

5.3.3 Network Effects, Critical Masses of Users, and Virtuous Cycles of Growth and Expansion

Network effects refer to the situation where the benefits of using a product or service grow as more people use it (Xiong et al., 2018, 1-8; Keese, 2016: 197-199). In the case of digital platforms, this means that as more users become part of the platform and participate in its activities, the platform's value increases, leading to a cycle of growth and expansion. The significance of comprehending network effects lies in the factor that they can form substantial obstacles for new competitors entering the market.

Once a digital platform has achieved critical mass and established strong network effects, it becomes difficult for new entrants to attract users and compete effectively. As a result, established digital platforms can enjoy significant market power and influence. Understanding network effects also helps to explain the business strategies of digital platforms (cf. Keese, 2016: 210-211). Platforms with strong network effects may prioritize user acquisition and retention, even if these strategies do not immediately generate revenue, because they understand the long-term benefits of having a large and engaged user base. Additionally, understanding network effects can also inform regulatory and policy decisions to consider the potential impacts of platform dominance on competition and innovation.

Direct network effects occur when more people join a network, leading to a positive effect for members (e.g., the more members a social network or a messenger service can aggregate), but negative externalities can also occur if the service is perceived as less valuable due to a smaller user base or lack of trust and security. There are also indirect network effects, where the platform's value rises with the increase in users on the other side of the platform, as seen in hotel search sites and food delivery services, or in online trading platforms. Cross-group network effects occur when expanding the supply of services / goods on a platform increases its appeal to potential consumers, resulting in positive effects on the same side of the platform, but negative effects can also occur (Clements, 2004: 633-645). Johnson (2017) explains that individuals' decisions can have direct or indirect effects on others in the same or interconnected groups. Group growth can benefit its members in two ways. First, group members directly benefit from group growth, such as with operating systems where users benefit when other users use the same system, allowing for information sharing and support. In addition, members can reap benefits indirectly from the expansion of one group when it motivates another group to grow, resulting in a favorable impact on the initial group. This can be seen in the case of software developers who create software for an OS that has a growing user base.

Literature (Xiong et al., 2018: 1-8; Evans/Schmalensee, 2016; Clements, 2004: 633-645) identifies two different types in relation to these network effects: seniority advantage and user base advantage. The former occurs when a player who has been in the market longer attracts more users, while the latter refers to the player with the largest user base, regardless of when it started. However, the mechanical understanding of these advantages has been questioned, as some platforms with larger user bases have not capitalized on their early start. Distinguishing characteristics can also stimulate network effects, however, competition in multi-sided markets necessitates tactics that account for both network effects. Practically, platforms are businesses that enable a direct communication between just two or more user groups, resulting in indirect network effects. This highlights the significance of indirect network effects in evaluating market power and distinguishes platform business models from traditional market relationships. This distinction is applicable in various cases, including matching

platforms, which aim to facilitate the optimal possible match between user groups, rather than transactions. It can be differentiated between matching platforms and attention-driven platforms. Facebook is popular because many users use it (Galloway, 2017: 96-125), Amazon sells various products directly or through third-party sellers on its online shop, which is presented as a single, integrated platform. Amazon's own retail business buys and sells goods under its name, while its marketplace business acts as an intermediary for transactions between sellers and buyers. Although Amazon's proprietary trading can be considered a part of the retailer user group, the existence and extent of indirect network effects between these groups are open to debate (Galloway, 2017: 13-62).

Network effects are important for platforms beyond the cited cases, such as the App Store and Play Store, which developers cannot ignore despite restrictive regulations. The relationship between a platform and its users can be viewed as a separate market, with one market encompassing two or more sides. Whether two-sided markets are separate, or a single market depends on the differing characteristics of the specific individual cases (Rochet/Tirole, 2006: 645-667). Platforms that facilitate transactions or matches between different user groups typically have a consolidated market, as the integration of both sides is crucial to the platform's functionality, and reciprocal indirect network effects are commonly observed. This is demonstrated by platforms that attract more providers who then use the platform and result in more consumers consulting the platform, leading to a positive impact on the third-party providers involved in the transaction. However, for platforms that are not transaction platforms, interdependencies between separate markets must be considered.

The domain of social media is one of the main arenas where the effects of network effects are highly significant. Platforms such as TikTok, Twitter, and Instagram have become essential tools for communication and social interaction, and their value increases as more people use them, creating a virtuous cycle where more users attract more users, and allowing these platforms to achieve massive scale and dominance in the digital landscape. Another key impact can be observed in online marketplaces where e.g., Amazon and eBay have become the go-to destinations for online shopping, in part because of the large number of sellers and buyers on these platforms (Galloway, 2017: 13-62). As a greater number of merchants offer their merchandise on digital platforms, more consumers are enticed, resulting in an increase in the platform's value for all members. Network effect has influenced how digital services / products are conceived and marketed. Corporations that achieve network effects can leverage their dominant position to promote creativity, allure more users, and defend against rivals. This has led to the development of platform-based business models, where firms like Alphabet and Apple (Galloway, 2017: 79) provide a range of tightly integrated products and services alongside their platforms.

The employment of network effect also raises concerns regarding the consolidation of power among a small number of major platforms, and the possibility for these platforms to suppress competition and constrain user options as they gain more control.

There is a chance that these platforms may take advantage of their market influence to demand high fees from users and suppliers, and to engage in activities that impede competition. As such, as from the perspective of CTT, the network effect has both positive and negative implications. As platforms grow, they can use their market power to impose rules on users and suppliers that may not be in their best interest, leading to a lack of choice and competition, and resulting in negative consequences for consumers and suppliers. Conversely, the network effect can enable digital platforms to provide a broad array of products and services at reduced prices, enhancing accessibility to consumers and presenting suppliers with opportunities to expand their customer base and boost earnings. Nevertheless, these advantageous effects of the network effect can only be realized if there is equilibrium in the power dynamics between the platform and its users and suppliers. This requires a regulatory framework that ensures fair competition, consumer protection, and data privacy. Without such a framework, the network effect can be used to further entrench the power of dominant platforms and undermine the interests of consumers and suppliers, rendering the network effect a double-edged sword.

5.3.4 Pricing Mechanisms, Value Exchange, Transactions, Monetization and Free Usage

Understanding value exchange and transactions is crucial when analyzing the impact of technology on the digital platform economy, as different groups of users participate in a multi-sided market or platform, such as purchasers and vendors, marketers and customers, or creators and users, exchange value with each other. These exchanges can take various forms, including monetary transactions, data sharing, or access to content or services. The way in which a platform is designed, including its pricing mechanisms, can have a significant impact on the value that is exchanged between its user groups, as well as on the long-term viability and success of the platform. In addition, the transactional nature of the digital platform economy means that issues such as trust, security, and privacy are critical to ensuring that value exchanges are carried out in a safe and ethical manner. Furthermore, understanding value exchange and transactions can shed light on the power dynamics within a platform ecosystem, where actors may engage in practices that favor one group of users over another, such as charging high fees to sellers or using data from users without consent - practices which can lead to imbalances in value exchange and hinder growth and innovation.

Platforms facilitate interaction between different sides, but the way they do it can vary widely. In some cases, platforms may choose to charge fees to one group of users participating in a transaction while providing free usage to the other group. Others may intervene by providing search options and support services for transactions, without participating in the transaction themselves. The level of contractual relationship between a platform and its users can also vary. In general, platforms have closer contractual relationships with users than traditional media, like free TV. A platform's pricing strategy is mainly based on external effects between its different sides. For example,

e-commerce platforms typically do not charge users who search for products, but instead collect fees from providers of goods. These prompts inquiries regarding whether the connection between a platform and its users can be deemed a market connection, particularly when there is no direct monetary transaction between them, as in the case of Google's free services. The way two-sided markets work suggests that a market exists even if products are offered in exchange for non-monetary consideration, such as data in the digital economy. Market participants or customers pay in the form of attention, providing information about their search behavior, shopping patterns, or preferences. This data is valuable to global platforms, allowing to adapt advertising offers to individuals and target content and advertising.

Digital platforms can employ predatory pricing tactics, where they set their prices below the cost to attract customers and eliminate competition, gaining a foothold in new markets. Amazon Prime is an example of a loss-making offer that may push competitors out of the market by providing free and timely delivery of products sold or shipped by Amazon. However, the disappearance of competitors from the market may also be the result of legitimate competition, and there can be legitimate reasons for prices below cost level, such as on multi-sided platforms where zero prices can result from competitive pricing. Other reasons for loss pricing can include pursuing a growth strategy for long-term economies of scale or the sale of remaining stocks. Ultimately, the success of such strategies depends on realizing higher prices in the long term after replacing competitors. As such, free services from platforms can be viewed as market relationships regarding the economic purpose of the multi-sided activity, regardless of which side involved shows the most considerable monetary profit. This means that even though some platforms may offer their services for free to some users, the goal of the platform is to generate revenue through multi-sided activities that involve various stakeholders, such as advertisers, sellers, and buyers.

Therefore, even if one side of the platform appears to be receiving the most significant monetary benefit, the platform's overall economic purpose is to make money through the interactions between all sides. This view sees the free services offered by the platform as part of a larger competitive economic strategy rather than a charitable gesture towards certain users. Stated differently, the presence of a user on a platform holds value even if the user does not pay directly for the service. The platform's financial prosperity is still linked to the user, as there remains a market-based relationship between the two parties. Furthermore, the user's data is an asset and can be utilized to leverage market influence, particularly for platforms that rely on digital advertising as their primary income stream. For example, ad-supported media platforms generate profits by displaying advertisements on their platform based on user data. The expenses associated with advertising may eventually drive up the prices that the buyers of the promoted products must pay, but users who disapprove of these advertising financing models must acknowledge that it would be challenging to offer these services at no cost without them.

Platforms have a non-neutral price structure (Rochet/Tirole, 2003: 990-1029; cf. Rochet/Tirole, 2006: 645-667), meaning that changes in the price structure can affect the volume of transactions processed by the platform. This is different from one-sided markets, where pricing usually equals marginal costs. Platforms in two-sided markets may use pricing strategies where they charge fees that are either below the marginal costs on one side of the market or above the marginal costs on the other side. The pricing on both sides is interdependent, so it is incorrect to consider the pricing of the two sides separately (Evans/Schmalensee, 2007). Digital platforms facilitate exchanges between providers and buyers and reduce transaction costs. For app developers, using an app store platform allows them to reach a vast audience with little marketing effort, as the platform's technical specifications enable easy and efficient development of the application. Unlike a retailer, a platform's primary function is to enable and facilitate direct interactions between parties, without actively participating in the transaction itself. Unlike a retailer, a platform has little or no influence on strategic decisions regarding the product, pricing, or other interaction parameters.

The different types that are being discussed in relation to digital platforms are transaction and non-transaction platforms (cf. Trabucchi/Buganza, 2019; Kolossovski, 2019; Niels, 2019). Transaction platforms allow for direct observable transactions between two sides, with both sides having the goal of achieving a transaction with the other. Positive indirect network effects are internalized by the platform, and both sides are necessary for the platform's existence. Non-transaction platforms also link two or more sides, but their interactions are non-specific (e.g., viewing advertisements) rather than direct transactions. Positive indirect network effects typically work in only one direction or user group.

An example of a transaction platform is Airbnb (cf. Hijrah Hati et al. 2021; Núñez-Tabales et al. 2020; Oskam/Boswijk, 2015: 22-42) which connects hosts who have accommodations available for rent with guests who are looking for a place to stay. Both hosts and guests have the same goal of completing a transaction - the guest wants to book a place to stay, and the host wants to rent out their space. The positive indirect network effects of Airbnb are internalized by the platform: as more hosts join the platform, there are more accommodations available for guests to choose from, which in turn can attract more guests to the platform. Similarly, as more guests use Airbnb to find accommodations, more hosts are incentivized to list their properties on the platform. The presence and engagement of both parties are crucial for the platform's operation and effectiveness, and Airbnb's success as a broker depends on facilitating interactions between hosts and guests. Instead, a good example of a non-transaction platform that presents a link between two or more sides but does not involve direct transactions is social media platforms like Facebook (Galloway, 2017: 96-125). Facebook connects users with each other and with businesses, but the interactions that take place on the platform are usually non-specific (such as scrolling through a feed or liking a post), rather than involving direct transactions. Positive indirect network effects

can be unidirectional, as observed on platforms such as Instagram, where the expansion of content creators (one set of users) positively influences the growth of users (another set of users) but not necessarily the other way around.

When analyzing concentrated markets like the digital landscape, it is crucial to consider pricing strategies, especially for two-sided markets where pricing for both sides is simultaneous and interdependent. This pricing includes factors such as demand elasticity, marginal costs, and network effects. Assessing the pricing strategies of a platform based solely on one user group is an incomplete reflection, as the pricing of one side cannot be compared to its marginal cost or a different competitive price for that side. Platforms may find it beneficial to set different prices on each side, even in a competitive market. One approach to pricing in a platform is offering free services to one side while charging the other side a price higher than the marginal cost. This pricing technique represents the influence of indirect network effects on the other side, essentially supporting it. To evaluate pricing strategies, it is essential to examine both sides of the platform, including the pricing framework and level. Such pricing may lead to the exclusion of other suppliers from the market, which could be interpreted as successful competition but may also reduce overall welfare by eliminating efficient providers, particularly in established markets (Rysman, 2009).

Lately, there have been growing trends towards dynamic and personalized pricing, particularly in e-commerce, where providers use data and user behavior to differentiate prices based on observed online habits and characteristics. This allows providers to calculate willingness to pay and risk of default more accurately, leading to an increase in offers and potential profits for powerful platforms. However, this type of pricing raises concerns regarding transparency, as data-based differentiation can lead to individualized pricing, which may pose challenges for consumer protection. It is important to determine whether dominant online platforms abuse their market power to harm consumers. While the classic example of a monopolist charging higher prices without competition does not seem to apply to many online platforms, some platforms offer services for free in exchange for valuable user data. This may be anti-competitive if the platform would pay for this data under competitive conditions, resulting in a negative price for platform usage. However, platforms also provide innovative solutions that reduce transaction costs and increase opportunities for direct exchange between market participants, leading to cost reductions and increased efficiency in various contexts (Mayer-Schönberger, 2017). When it comes to user behavior and the use of multiple platforms or a single platform, exclusivity agreements can have competitive effects. When a platform has exclusive agreements, it can reinforce its dominance. The broader the platform's influence, the more appealing it becomes for exclusive deals from one group of users. As a result, this strengthens the other user group and creates an obstacle to entering the market.

One of the most significant impacts of value exchange in the digital platform economy is on the creation of new business models, as can be demonstrated with e.g., Airbnb, Uber (Kooti et al., 2017: 574-582), or Etsy (Church/Oakley, 2018: 1-21) who

have all created new business models that rely on value exchange between different parties. Airbnb enables homeowners to rent out their homes to travelers (Oskam/Boswijk, 2015: 22-42), Uber connects drivers with passengers who need a ride, and both business models rely on the exchange of value between the platform, the service provider, and the user. Another impact of value exchange can be seen on the creation of new forms of value, such as social capital, reputation, and influence. Social media platforms enable users to build large followings and influence others, which can be monetized through sponsorships and other forms of advertising. Value exchange also had impacts on the employment, as digital platforms rely on the exchange of value between workers and platform owners, e.g., TaskRabbit and Upwork enable freelancers to offer their services to clients around the world, while platforms such as CrowdFlower enable workers to complete micro-tasks in exchange for small payments.

Regarding fairness and equity, though, workers on gig economy platforms may not be protected by traditional labor laws protection and may not receive the same benefits as traditional employees. Concerns about data exchange also prevail. As for the CTT perspective, the exchange of value in the digital platform economy can be understood as a power struggle where the dominant players like advertisers and platform owners prioritize their interests over the users. This asymmetrical relationship is maintained through the monetization of user data and the asymmetry of information, resulting in a power imbalance. Users are often lured into providing their personal data in exchange for free access to services, which creates a false sense of value. The value of personal data is often underestimated and used to generate profits for platform owners and advertisers, while users have little control over how their respective data is used and monetized. The result is a situation where users are providing labor and data for free, while the profits are reaped by platform owners and advertisers. In addition, value exchange within the platform economy encompasses more than just the transfer of data, as it also shapes a digital culture that prioritizes specific values and behaviors while marginalizing others, e.g., platforms may prioritize certain types of content and users, leading to marginalization of certain groups and to reinforcement of existing dynamics.

5.3.5 Scaling and Scalability of Platforms When Handling User-Growth, Transactions and Data

Scaling and scalability are a key characteristic and growth principle of the digital platform economy (cf. Keese, 2016: 165-192). Scalability pertains to a platform's capacity to cope with an increasing volume of users, transactions, and data without having any detrimental impact on performance or service quality. Meanwhile, scaling refers to the methods employed to achieve scalability, which may include implementing new technologies, processes, or infrastructure. In a digital platform economy, the ability to scale is critical for platform providers to remain competitive and grow their user base. As more users join a platform, the value of the platform increases due to network effects, leading to a positive feedback loop of increasing value and user growth. However, if a platform is unable to scale up its capacity to handle the growing number of

users and data, it may experience performance issues, data breaches, and loss of user trust and engagement. Therefore, it is important for platform providers to design their systems with scalability in mind and invest in technologies and infrastructure that can support the platform's growth. This requires a deep understanding of the platform's underlying architecture, the potential bottlenecks in the system, and the ability to anticipate and plan for future growth. As platforms become dominant players in their respective markets, policymakers must consider the potential negative effects of platform monopolies and ecosystems and ensure that competition and innovation are not hindered. This requires a nuanced understanding of the interplay between scaling, network effects, and competition.

Digital platforms differ significantly from traditional platform models due to their strong and positive economies of scale (Linden, 2016: 1-3), which arise from the utilization of digital technologies and intangible assets. The development of digital products or services results in minimal additional costs for other users, leading to much greater impact on economies of scale than in conventional companies. For instance, uploading a new video on an already functional video platform hardly incurs any additional costs. As the total number of users overall on digital platforms increases, the cost per user declines dramatically, resulting in much faster cost decreases than would be the case for physical production. This cost reduction is due to the fixed costs of producing and marketing a piece of digital content, such as music or movies, and the close-to-zero production costs for an additional unit. While platform providers, such as YouTube and Watch, incur high initial costs in setting up and running the platform infrastructure, the addition of more users does not lead to significant costs. Hereby, data is essential for digital business models, leading to economies of scale. For example, in AI, having more and better-quality data can create stronger economies of scale based on data. Platforms that have a lot of data can have a competitive advantage, as they can improve their services and attract more users.

Digital markets benefit from a network of investors that enables the scaling of business models (cf. Lynn et al. 2022: 69-89), creating a challenge for competition policy due to entry barriers, one-sided dependencies, and the dual roles of platforms. However, this scalability also creates new challenges that must be carefully considered (cf. Mayer-Schönberger, 2017). Large data sets are a competitive advantage for data-rich platforms, resulting in feedback loops and better services, as discussed. In the digital world, physical and geographical restrictions have become less important, as consumers can access digital products from multiple platforms simultaneously. Nonetheless, capacity limits, as in the case of sufficient server capacities, can affect digital platforms. The advertising space on advertising-financed media platforms is also limited, and user tolerance for advertising also limits the available shelf space. Unrestricted growth can have detrimental effects on digital platforms, as managing different business areas and employees can be complex, leading to competition between products owned and operated by the same company.

Internet companies can also leverage economies of scope (McGee, 2014a: 2) to gain a possible competitive advantage. These companies benefit from a competitive research environment, the ability to translate research into commercial applications, a willingness to take entrepreneurial risks, flexible labor markets, and attractive investment terms (cf. Chavas/Kim: 2007: 411-427). Large ecosystems that offer many products / services can benefit from possible economies of scope by using data from multiple sources more efficiently and effectively. This can result in blurred lines between different markets and companies with detailed data records. Platforms can use their knowledge about their users to create opportunities to enter adjacent markets, e.g., by bundling or adding additional features using network effects. Bundling services can reinforce a company's market position, enhance economies of scope, and transfer market power and network effects to new markets that may be difficult for competitors to penetrate. However, diversification into new markets can lead to intensified competition in those markets. Consumers can benefit from bundled services if quality improvements or advantages in purchasing several services from a single source can be achieved (e.g., Apple's services, cf. Galloway, 2017: 79).

On a practical or technical level, scalability is usually achieved through a combination of hardware and software optimization, architecture design, and network infrastructure. At the hardware level, platforms need to ensure that their servers and other computing equipment have sufficient processing power, memory, and storage to handle the growing demand, requiring the use of advanced hardware components, such as high-speed processors, solid-state drives, and cloud-based infrastructure services. At the software level, platforms need to ensure that their applications and services are designed to handle high traffic volume and user demands, involving the use of distributed computing architectures, load balancing algorithms, and data partitioning techniques. Platforms may also employ caching mechanisms, data compression, and other optimization techniques to improve the speed and responsiveness of their services. From an architectural standpoint, digital platforms must guarantee that their systems are built for high scalability. This requires utilizing a microservices-based approach, which fragments applications into more controllable services that can be deployed and scaled independently as per requirement. It may also involve the use of containerization technologies (Bentaleb et al., 2022: 1-26) which enable applications to run consistently across different environments and can be easily scaled up or down depending on demand. Finally, network infrastructure plays a critical role in scaling platforms, as platforms need to ensure that their networks can handle the growing volume of data traffic and users, which involves the use of CDNs (cf. Zolfaghari et al. 2020: 1-34) to cache data in multiple locations worldwide to reduce latency and improve the speed of content delivery. Platforms must also guarantee that their networks are constantly accessible and duplicate, with various data centers and failover mechanisms to forestall service interruptions or downtime.

One key example of this impact is the success of online marketplaces such as Amazon and eBay, as these platforms have been able to scale and grow rapidly, enabling

millions of sellers to reach a large audience of potential buyers. The digital platform economy has generated benefits for both vendors and consumers. Vendors can access a broader market, while consumers have greater access to a diverse array of products at competitive prices. However, the success of these platforms also depends on their ability to maintain high levels of trust and of security, as well as efficient and reliable logistics and payment systems. Another example of the impact of scaling and scalability is the growth of ride-hailing platforms (e.g., Grab), which provide a convenient and affordable alternative to traditional cab services.

The platforms' ability to scale up has raised apprehensions concerning their labor practices and competition. This is particularly significant because the success of these platforms depends on their capacity to strike a balance between the supply and demand of drivers, as excessive drivers can lead to reduced earnings, while inadequate drivers can lead to longer wait times for passengers. As such, from a CTT viewpoint, scaling and scalability raise important questions regarding power dynamics, social inequality, and the relationship between technology and economy. On the one hand, scaling is often seen as a positive development that enables to reach wider audiences and generate greater value for their stakeholders (McGee, 2014b: 1-4), however, from a critical perspective, the focus on scaling can also mask important social and political issues related to the design, use, and governance of digital platforms. For instance, scaling often involves the accumulation of data, network effects, and the establishment of dominant market positions. This can lead to winner-takes-all dynamics (Andrews et al., 2016:12), where large platforms exert significant influence over markets, user behavior, and public discourse. Such concentration of power can undermine competition, limit user choice, and exacerbate social inequalities. Furthermore, the push for scalability can also result in the commodification of user data and work, which can have negative consequences for privacy, autonomy, and workers' rights. In many cases, the platforms that scale the most effectively are those that rely on algorithms and automation to extract value from users and generate revenue, leading to the exploitation of vulnerable groups, such as low-wage workers.

5.3.6 Data Collection, Exploitation, Monetization at the Expense of Data Privacy and Ownership

Comprehending the exploitation of data is of paramount significance in assessing the influence of technology on the digital platform economy since data is now a vital element of several platform enterprises. Data can be exploited in many ways, including data collection, analysis, and monetization. Platforms can use data to develop better products and services, optimize their business models, and increase user engagement. The data then can also be monetized by selling it to advertisers, third-party app developers, or other businesses. Given this impact of .data, the exploitation also raises important ethical and legal concerns. Users may not fully understand how their data is being collected and used, and there are risks of data breaches and misuse. There are

also concerns around data privacy and ownership, as well as the potential for discriminatory practices based on data.

From a technological standpoint, it is crucial to recognize that online platforms are heavily dependent on data to operate effectively (Mayer-Schönberger, 2017). Data refers to information gathered from users or machines, obtained from available sources or existing data through analysis. Combining data from multiple sources can increase its value and create a competitive advantage. However, data can also act as a barrier to entry, as the amount of data required for a successful offer and its impact on the quality of services is uncertain. Data can also drive innovation in product development and lead to closer user-platform relationships through personalized services. Evans et al. (2016) suggest that data-based individualization of platform services can discourage consumers from using multiple platforms or switching to other providers who lack a corresponding data history to offer the same level of customization. The lack of data access for competitors, especially for complementary, horizontal, or vertical products and services, can result in a lock-in effect. This may lead to customers being forced to stick to a provider, even if they don't like it.

Digital platforms connect individuals and organizations on different sides, and the challenge lies in identifying the demands of each user and its counterpart. To achieve this, platforms collect vast amounts of data and use analytics systems to identify behaviors, tastes, and interests that can be translated into goods / services offered to users. This data is also utilized to make public service providers more vulnerable and to identify potential customers through personalized advertising mechanisms. The key value for platforms lies in IP, the network, and access to participant data, which is growing exponentially as platforms strive to gather the most complete data collection. Platforms such as Meta rely on users willingly providing personal information, which is then used to guarantee advertising partners that their ads are reaching the right target group. The ability to analyze data and extract insights on individual or group behavior is fundamental to the business models of all platform operators. As platforms connect different sides, data is a key input for the relationships that occur in the most direct and precise possible manner, such as providing a delivery address on Amazon or linking a cell number for a ride on Uber.

Data collection is based on personalization of user participation in online spaces, with a distinction between data as an input for trade with third parties and data as the traded good itself. The latter is not yet dominant and often occurs outside the online world. Increasingly, activities require user identification and registration, which creates several levels of identification and control over data and activities (surveillance through data, cf. Westerlund et al. 2021: 32-44). Platforms like Facebook or TikTok (Miltsov, 2022: 664-676) rely on customization to meet the respective demands of their users and can reduce the limitations of potential audience. The data collected and analyzed allows for a more precise and targeted approach to advertising, unlike traditional media where advertisers may face challenges in determining the impact of their ad spend.

Many online platforms rely on data-based products / services as the core of their business models. Collecting and evaluating data can lead to improvements in service quality, such as tailoring services to individual customer needs. Implementing data-driven processes and utilizing AI can contribute to increased efficiency by facilitating quicker error detection and promoting innovation. Unlike conventional production inputs, data can be used by multiple market participants simultaneously. Protecting business secrets, privacy, and data protection for personal data, maintaining investment incentives for data collection, and developing analysis methods are important considerations for data gathering (Hamann, 2018).

Multinational platforms have collected an unprecedented amount of data over the years, giving them an unparalleled advantage. However, this concentration of power poses risks to other market players and the common good if platform operators set the rules of market participation. SMBs using these platforms may face unfair practices such as limited access to customer data, unfair terms and conditions, and preferential treatment for the platform's own offers. The quality of data collected is also important, as not all data generated by a company may be useful for achieving business objectives. While collecting data is important, the real challenge is analyzing it to gain insights and a competitive edge. Companies that can effectively use algorithms to analyze their data have an advantage, particularly in the field of AI, where large data sets are crucial. According to Varian (2018), the ability to utilize data, rather than the data itself, is what is scarce in the field of AI. Companies with detailed and extensive data sets are better positioned to develop new products / services which are based on data analysis. While the competitiveness of smaller companies also requires data-based innovations (cf. e.g., Sundu et al., 2022: 149-175; OECD, 2000: 17), sharing data, whether in the form of user profiles or anonymous datasets, can promote competition and innovation overall. Collecting and processing data can be costly, having exclusive access to datasets can be a necessary incentive to bear the costs for creating it. Any interference with data exclusivity can affect the willingness to collect data and have a negative impact on innovation.

Digital platforms create a competitive environment for manufacturers and dealers and take over customer contact, which is crucial for pipeline companies, potentially reducing the importance of sales related USPs and intangible values (Sicoli, 2018: 161). Enforced price transparency can lead to price reduction, shifting prosperity away from manufacturers towards customers and platform operators. Data is a new currency in the digital platform economy, enabling improved matching algorithms, target-specific selection of user data for advertising partners (cf. Parker et. al., 2017), and increasing knowledge about users. Digital platforms can grow quickly due to being implemented through IT systems and as they don't require classic production factors, which reduces capital commitments and outsources risks to third parties, resulting in the ability to expand rapidly at a minimal cost. As more products, partner interactions, and transactions occur, economies of scale increase, overcompensating for original start-up costs. Digital platforms can also benefit from niche content, regardless of whether customers

pay with money, data, or attention. Digital providers of goods such as music on e.g., iTunes or Spotify can offer many articles on the market at a low cost due to minimal storage and capital commitment costs. This allows for the offering of niche content that might be unprofitable in traditional physical stores, but which attract customers and small providers to the platform. Customers benefit from a central search algorithm that allows them to access a wide variety of niche offerings.

Misuse of market power can occur when online platforms have excessive access to user data, which can lead to benefits created from this advantage. Concerns about data collection are often raised due to potential data misuse through excessive collection and commercial use, and the violation of data protection regulations. The rise of digital platforms has prompted an upswing in antitrust reviews across different regions. User data is typically gathered through users accepting the general terms of online platforms, which raises concerns about customer protection. Customers can explore alternative providers with less onerous general terms and conditions that relate to data. The agreement to the collection of personal data is often included in the ToS of online platforms, which may be considered an abuse of terms if they differ from those of effective competition. The use of inappropriate ToS by dominant companies may constitute market power abuse, particularly in the context of data collection, and overindulgence in data gathering can be evaluated in terms of exploitation of terms, beyond infringement of data privacy regulations. However, there is no clear benchmark for determining excessiveness from a competitive standpoint, which can pose challenges in determining abuse of control. Traditional concepts of abuse require a comparison of the entire bundle of services and conditions, making it difficult to assess.

In the digital economy, data can be a strategic interest in mergers. Combining established platforms with innovative newcomers can provide new data access and increase data concentration in the market. However, such mergers can also reduce innovation potential and increase vulnerability of existing market positions, making access to data indirectly impact competitive assessment. This has led to new forms of mergers in the digital platform economy, such as demand-side mergers that benefit supplier-side synergy effects by linking data from different sources. Although data concentration may not necessarily be a competitive issue, data protection regulations should be considered, especially in data-driven mergers. Data protection is a factor of non-price competition. When a merger limits user alternatives to obtain the same service without leaving data traces, it can negatively affect customers and pose a regulatory challenge. Evaluating such forms of deterioration is difficult because less data protection can also lead to product improvements that customers do value. Regulations that allow for simplified data transfer between platforms can have positive effects on competition but also raise data protection concerns. Opening access to an essential resource may not eliminate data protection issues but increase them.

As evidenced, the gathering and utilization of data have significantly affected the digital platform economy in terms of its economic aspect. The massive amounts of data generated by digital platforms has enabled businesses to understand their customers

in unprecedented detail and has transformed the way that they engage with their users and in relation to advertising. Companies such as Alphabet have been able to utilize this data, they collect about their users to create highly targeted advertising campaigns that are more effective than traditional advertising methods, enabling businesses to reach their ideal customers with a higher degree of precision, and has led to the rise of digital advertising as a dominant force in the advertising industry. An important factor is related to product innovation, where corporations employ data to gain a deeper understanding of their clients' desires and inclinations. By utilizing this information, companies can design services / products that are customized to their users. This has led to the emergence of data-driven product development, where enterprises utilize data analytics to inform every aspect of the product development cycle, from conception to rollout. Data collection and utilization have also influenced the future of employment, where companies use data analytics to better understand the productivity of their workers and use this knowledge to optimize operations, leading to the rise of algorithmic management, where algorithms monitor and control workers' behavior.

Despite these positive effects, data collection and exploitation also raise concerns about privacy and security, as companies collect more and more data about their users, implying the risk that this data could be misused or hacked, leading to breaches of privacy and security. In addition, there is the already mentioned concern that the use of data could lead to discrimination against certain groups, such as minorities or people with disabilities. These issues together reflect CTT concerns in relation to power dynamics. Platforms often conceal or obscure their data collection practices, making it challenging for users to comprehend the full extent of how their data is being gathered and utilized. This lack of transparency might be perceived to manipulate users, as their personal data is being collected without their complete understanding or agreement. Furthermore, platform owners retain their authority and influence over the market through data analysis, acquiring knowledge about user actions, preferences, and requirements, which can be leveraged to shape the platform's design, functionality, and targeted advertising, among other monetization tactics. This creates a feedback loop in which the platform becomes more powerful and dominant, while users become more dependent on the platform for their online activities. Unequal distribution of benefits derived from data collection and exploitation is another aspect. Platforms retain control over the data collected, while users do not have access, resulting in users being exploited, while the value generated from data is captured by platform owners.

5.3.7 Interdependent Relationships Between Different Entities and the Formation of Ecosystems

Ecosystems are the foundation of platform-based businesses and are characterized by interdependent relationships between different entities, such as users, developers, content providers, and third-party service providers. Platforms that can establish and sustain powerful ecosystems can generate substantial network effects, making it more challenging for rivals to penetrate the market. Additionally, a strong ecosystem

can create a virtuous cycle of innovation and value creation, as more developers and content providers are incentivized to join the platform and create new products and services that attract more users. However, building and managing ecosystems can also pose significant challenges. Platforms must balance the interests of different ecosystem partners while maintaining a consistent user experience and managing potential conflicts of interest. Regulators may also examine ecosystems, particularly in cases where a platform holds significant market power.

Digital services like search engines, social media, and e-commerce sites have created conglomerates dominating specific markets and expanding beyond their original market, using technological power and infrastructure. Digital platforms are typically large and dominant in their respective markets, but differentiation through various functionalities or target groups can offer competition and decrease market concentration (cf. Evans/Schmalensee, 2007: 151). Digital ecosystems are expanding to reach various industries and human experiences. Despite the increasingly intricate nature of digital technology and its support for information-based activities, a substantial segment of the population remains deprived of access to these technologies (Kemp, 2020).

In discussions about digital ecosystems and large companies, it's often assumed that they hold economic power due to their high number of users and advertising revenue, as they act as a link between buyers and sellers, with commercial customers on the sellers' side also being relevant users. In the digital economy, there are high levels of market concentration and strong platform positions due to technological development, usage behavior, and network effects. Market shares are meaningful for larger networks as new users tend to prefer them. However, an increase in market share doesn't necessarily lead to a loss of competition if the market is still vulnerable due to low entry barriers and changing user preferences. Monopoly positions in digital markets can have negative effects on innovation and efficiency (cf. Keese, 2016: 193-227).

Digital platforms operate in marketplaces where the operation and marketing of the platform are included in the information system's task portfolio (Iansiti/Levien, 2004). In the digital realm, success factors for ecosystems differ from those in the physical world, with holistic specialization being one of the key factors. Specialization reflects a market-driven view of specific customer solutions that is a success factor for digital platforms, such as highly specialized internet-based data storage platforms. Once a digital platform reaches a critical mass and continues to grow, the goal is to further bind users to the ecosystem through new or third-party services. One should not mistake the array of products / services offered by a digital ecosystem as a strategy for diversification that aims to combine dissimilar offerings to reduce risks. Instead, digital platforms continuously broaden their scope of products / services to retain users and boost their platform engagement time, which is a crucial performance indicator in platform-based economics. To determine what is lacking for specific groups and where acceptance issues lie, platforms use information technology to remedy bottlenecks. Services are offered through web and mobile apps, integrating into users' everyday

lives. These systems and database queries must function quickly and intuitively to ensure a simple user experience.

As such, digital platform economy's dominant players have rapidly emerged and invested in customer-benefiting innovations. For instance, the Google Play App Store provides millions of apps to download globally, with the use of hardware components enabling unimaginable applications. Amazon Video, part of Amazon Prime's bundle of customer benefits, offers a vast content library across various devices. These ecosystems create multiplied benefits for customers, fostering loyalty and establishing barriers to leave the platform. In contrast to services provided by e.g., broadcasters, digital platforms enable a user-centric approach where customers have the freedom to select the content they prefer to consume (in this case, to watch). By using AI techniques to analyze viewing habits and customer data, the platform can offer personalized suggestions for new content. This analysis of customer data is a powerful tool that allows platform providers to control the rules of interaction and information exchange, thereby influencing the competition on their own platform. This can lead to market power positions that favor the platform's own products / services, such as an app store that competes with third-party providers or a mobile OS that has a pre-installed messenger system (as is the case with Apple’s Messages app), giving it an advantage over other messenger apps.

Platforms may face conflicts of interest between maximizing income through placement services and providing valuable recommendations to customers that increase sales of the platform's own products. This lack of transparency can lead to competition distortion, displacement of competitors, and the transfer of market power to neighboring markets, ultimately building an ecosystem. Platforms often expand their own placement services to create an ecosystem that provides access to their own interfaces, allowing app developers to use the platform's user base to grow. However, if a platform continually scrutinizes these interfaces, they can recognize potential competitors and either exclude them from the platform or replicate their functionality. While there may be legitimate reasons for refusing access to a platform's resources, platforms can use this to protect their market position in the long term (cf. Eisenmann, et al., 2008: 9).

Network effects usually lead to concentration, but alternative service delivery routes can increase competition and shift market power to certain players. Digital platforms are interconnected networks of services and assets, and various combinations of these nodes offer different routes for digital services. Bundling different services can transfer market power and network effects to new markets, making it difficult for competitors, while consumers may benefit from quality improvements or advantages in purchasing multiple services from a single source. Kerber/Schweitzer (2017: 39-54) raise concerns about concentrated ownership in digital platforms where the growing user base can make the platform a gatekeeper, reducing the likelihood of users switching to another platform without interoperability (Diallo et al. 2011: 84-91; Hodapp/Hanelt, 2022).

Digital platforms that have successfully built an ecosystem, however, employ advanced techniques beyond traditional strategies like product bundling. Platforms use various techniques such as visual presentation and default settings to influence the behavior of their users, including placing certain options or recommendations more prominently on the screen or setting default options that guide users towards certain actions. These techniques can have an impact on customer protection and raise concerns about the effects on competitors. From a customer protection perspective, there might be a lack of transparency and possible misleading information for users, e.g., if spaces on a website that are allocated to advertisements cannot be distinguished from regular offers of that specific website, users may be misled into clicking on advertisements without realizing it. From the perspective of competitors, if the platform is giving preference to its own products / services through these visual presentation and default settings, this could have an impact on their ability to compete. It could result in a transfer of market power to the platform's own ecosystem, making it difficult for other competitors to access the same user base or market.

The impact of ecosystems in the digital platform economy can be demonstrated by the Apple App Store as an example (cf. Bergvall-Kåreborn/Howcroft, 2013: 280-289), which serves as an ecosystem for app developers and users and provides a centralized platform for app discovery and distribution, enabling developers to reach a broad audience and monetize their apps. The service also provides tools and resources for developers to create high-quality apps, such as development kits, testing tools, and marketing support. In turn, users benefit from a wide selection of apps that are easy to find and download, creating a positive feedback loop that drives the growth of the ecosystem. Another example is the Google Ads ecosystem, which enables advertisers to reach a vast audience through the company’s search engine and other platforms (Galloway, 2017: 126-156). This ecosystem consists of various components, such as ad formats, targeting options, bidding strategies, and reporting tools. Advertisers can leverage these components to create highly targeted and effective ad campaigns, while Alphabet benefits from increased ad revenue and user engagement. It also supports third parties, such as ad agencies and technology vendors, who offer complementary services to advertisers.

From a CTT perspective, ecosystems in the digital platform economy can be analyzed as a phenomenon that reinforces and reproduces dominant power structures and, therefore, inequalities. The emergence of ecosystems has been driven by an economic logic that prioritizes profit over the common good, resulting in a concentration of wealth and power in the hands of a select dominant actors. Platform ecosystems are also not neutral spaces, but reflecting and reproducing the values, norms, and interests of their designers and owners. These interconnected networks facilitate the accumulation of immense volumes of data and the manipulation of users' focus, resulting in prevalent worries regarding confidentiality, safety, and independence. Ecosystems can be characterized by a winner-takes-all dynamic (Andrews et al., 2016:12) as has been

demonstrated. This dynamic is reinforced by network effects and data-driven economies of scale that allow dominant actors to leverage their power and control access to critical resources, such as data, users, and developers.

5.3.8 Concentration as a Result of M&A, Network Effects, and Economies of Scale and Scope

The concentration of power in the digital platform economy is a critical issue and has considerable implications for various aspects of economy and society, one of the most important being the impact on competition. Concentration can lead to the creation of dominant players that are able to maintain a stranglehold on the market, effectively crowding out smaller players and reducing competition, with negative consequences for innovation, as smaller players may be unable to compete with the dominant firms, which can result in a lack of diversity and stifle the development of new ideas and technologies. Concentration can also lead to the creation of powerful gatekeepers and ecosystems who can control access to markets and information, leading to implications for the distribution of wealth and power, as gatekeepers can determine who has access to economic opportunities, and who does not.

Concentration in the digital platform economy can occur through various mechanisms, such as mergers and acquisitions (M&A), network effects, and economies of scale as well as the possible economies of scope. M&A can result in the concentration of market power in the hands of a few dominant players, as companies can acquire smaller firms or rivals, thereby reducing competition and increasing their market share. Over time, concentration can become more pronounced as dominant players use their market power to prevent new entrants and maintain their position. They can do this by creating high barriers to entry, such as high switching costs for users, creating proprietary technology or data, and using anticompetitive practices. These include predatory pricing, exclusive contracts, and discriminatory practices that favor own services.

In terms of possible avenues for expansion, integrating companies, products, and services within the same group, either horizontally or vertically, is a common practice (cf. Lara, et al., 2020). Horizontal integration involves owning and controlling goods / services produced by competitors in the same market, while vertical integration (cf. Galloway, 2017: 194-195) involves owning and integrating multiple sides and stages of the production chain. This is achieved through the enclosure and exclusive linking of stages, which are referred to as closed systems or walled gardens (Hazlett et al., 2011; De Poulpiquet, 2017). Amazon has partnered with several logistics companies for its deliveries, and digital platforms diversify their activities beyond their initial focus through product extension or conglomerate merger (Galloway, 2017: 13-62). Start-ups often rely on scaling strategies to generate a large user base through free services and monetize in later phases. Incorporation is another way to expand, involving acquiring other actors in the same market, either horizontally by acquiring competitors, or vertically by acquiring agents from other levels of the production chain. For example, Meta's

acquired Instagram in a deal worth $1b (Frier, 2022; Kumar, 2019: 321-327), going public with 421,233,615 shares at $38 per share. Alphabet has executed 259 acquisitions, according to statistics provider Crunchbase (2023). Defensive leveraging (Schmidt, 2009) are competitive practices aimed at creating barriers to entry. Companies leverage their dominant position to expand into new markets (e.g., Microsoft by pre-installing WMP on its OS). Horizontal expansion is a common practice (the expansion of Amazon into new services is an example of this, cf. Galloway, 2017: 13-62).

The digital economy raises questions about the acceptability and longevity of temporary market power, as most dominant companies eventually become vulnerable. Market share is just one indicator of market power, and other factors next to others, such as IP rights and user data. Strong market positions in digital markets are often temporary due to rapid innovation and low technical barriers to entry. While network effects can lead to lock-in, switching costs are usually low, allowing users to use multiple platforms. Advertisers also take advantage of this by distributing campaigns across multiple competing platforms. Dominant companies may use their position to hinder competition in upstream or downstream markets and transfer their market power to a neighboring market to maintain their dominant position, which can impede innovation from competitors. When entering a neighboring market, the dominant company may need to assert itself in the new product / service, which can lead to synergy effects in technological developments and access to complementary data sources. Assessing these strategies in dynamic markets can be challenging as it can be difficult to distinguish between crowding out of competitors and genuine innovation that enhances customer benefits.

A prominent example of concentration in the digital platform economy is the online retail sector, where Amazon dominates the market as the largest online retailer in the world with a significant share of the e-commerce market (Galloway, 2017: 54-56). Its market power has been growing over time, and it has been able to leverage this power to enter new markets and drive out competitors. Amazon has built an ecosystem around its platform that includes third-party sellers, delivery services, and advertising services. By offering low prices, fast shipping, and a wide selection of products, Amazon has attracted a large and loyal customer base (Galloway, 2017: 32-39), however, it has also been accused of using its market power to disadvantage third-party sellers on its platform, such as by promoting its own products over theirs, setting fees and commissions that some argue are too high, and using seller data to inform its own product offerings (Galloway, 2017: 52-54). This concentration has led to concerns about the impact on competition and innovation. Amazon's dominance stifles competition and limits consumer choice by making it difficult for new entrants to enter the market. Conversely, it is worth noting that Amazon's platform has also served as a vehicle for SMBs to expand their customer base, and the company's substantial investments in logistics and technology have had positive ripple effects across the entire industry. The concentration in the online retail sector is not unique to Amazon. Other major players include Walmart, Alibaba (Galloway, 2017: 2020-221, 206-210), and

eBay. However, Amazon's market power and ecosystem make it a compelling example of concentration (cf. Galloway, 2017: 13-62).

The concentration of power in the hands of select digital platform companies can thus contribute to the exacerbation of existing inequalities, as those who are excluded from these platforms may be left behind in the digital economy. Another important implication of concentration in the digital platform economy is the potential for these platforms to become too big to fail. If a large platform company were to fail, it could have significant ripple effects throughout the economy, potentially leading to job losses and other negative consequences. This means that regulators may need to take steps to prevent excessive concentration and ensure that the digital platform economy remains stable and resilient.

CTT provides a lens through which the concentration in the digital platform economy can be considered, pointing to power relations and to the facts that digital platforms are social and economic systems that influence and are influenced by society, and that they have the power to shape and control economic and social relations. This concentration of power leads to a concentration of resources, which allows platforms to control development and direction of technology, and as well as the way it is being used, thus shaping values, beliefs, and norms through the information and content they provide to users and impacting social and cultural diversity.

5.4 Downstream Societal Matters affected by the Digital Platform Economy

5.4.1 Legislation to Address Competition, IP Rights, Data Protection, and Content Moderation

5.4.1.1 Governing the Dynamic and Innovative Digital Platform Economy

As the influence of digital platforms on human interactions persists, governmental and regulatory entities are progressively seeking to intervene to safeguard customers, encourage competitive environments, and ensure ethical conduct. Legislation also addresses issues such as IP, privacy, security, and content moderation. Legislation is needed to regulate the use of personal data by digital platforms, prevent anti-competitive behavior, or ensure that workers on gig platforms are afforded appropriate protections. Furthermore, the global nature of the digital platform economy means that there are often multiple jurisdictions with different laws and regulations, adding a layer of complexity to platform operations. Understanding the legal landscape in each market is essential for platforms looking to expand internationally. Legal frameworks can exert a substantial influence on the competitive environment of the digital realm of the platform-based economy. Rules and directives that restrict the authority of dominant platforms or establish impediments to entry for emerging players can mold the composition of the market and influence the effectiveness of platforms. Antitrust enforcement, data protection laws, and content moderation regulations are some common forms of intervention, while legislation governs digital platform operations and the conduct of companies within the digital economy.

There are multiple reasons why it's important to understand the impact of legislation on users and customers in the digital platform economy. The digital platform economy is characterized by an asymmetry of power between platform operators and users, where the former possesses a significant amount of control over the latter, creating a need for legal frameworks that can ensure that the interests of all stakeholders are protected and that users are not exploited or subjected to unfair practices by platform operators. The digital platform economy is highly dynamic and innovative, which means that traditional legal frameworks may not be well-equipped to deal with the unique challenges posed by this new form of economic activity. The digital platform economy requires legislation to adapt legal frameworks, which is important to balance innovation and stakeholder interests. Due to the global nature of the platform economy, legal frameworks vary across different jurisdictions, and harmonization of these frameworks can promote a fair environment for both platform operators and users, thereby supporting innovation and transactions.

Governments, businesses, academics, and civil society worldwide have become concerned about regulating digital platforms, enterprises have requested regulation of OTT services or deregulation of traditional sectors to balance competition. This has been raised in various countries and international organizations like the ITU, which passed a resolution in 2018 recognizing the interdependence of these actors. Governments also see the importance of this issue, as shown by the French President's joint document (French Ministry for Europe and Foreign Affairs, 2018) with governments and civil society organizations in the 2018 Internet Governance Forum. This document proposes a complex agenda to regulate services as an alternative to the dichotomy between two Internet models associated with the US and China. The document advocates for defending an open, safe, stable, and accessible cyberspace, applying offline laws to the online environment, and ensuring trust, security, and stability in cyberspace. Private sector actors are also acknowledged to have a responsibility in preventing cyber threats and malicious practices like election interference.

The UN special rapporteur on freedom of expression published a report (Kaze, 2018), on regulating third-party content on internet platforms, expressing concern about excessive demands for censorship or criminalization of content by governments and platforms, which could result in the removal of legitimate speech. The report emphasized the need for balance between fair motives, such as privacy and national security, and freedom of expression for those who publish on these platforms. It also highlighted the risks of giving too much power to private companies to decide what can be published, including vague prohibitions and limits on automated systems, which could lead to censorship and reduced freedom of expression. To prevent both state abuse and negative impacts of private regulation, it recommended adopting human rights standards in content moderation and deletion. The instances given illustrate how the legal framework has a substantial impact on shaping the digital platform economy, particularly in domains such as competition laws, IP rights and data privacy.

A concrete instance of the legal framework affecting the digital platform economy is the European Union's GDPR (n.d.), which was put into effect in 2018. The GDPR imposes strict requirements on companies regarding the collection, processing, and storage of personal data, giving users more control over their data and providing penalties for non-compliance. As a result, companies had to make significant changes to their data collection and privacy policies to comply with the according regulation. Another example of legislation impacting the digital platform economy is antitrust regulations. The dominance of tech giants in the market has become an increasingly pressing issue in recent years, prompting growing concern among various stakeholders. The US government and European Union have launched investigations into these companies for anti-competitive practices consequently. In the digital platform economy, IP laws are of significant relevance, specifically in the areas of patents and copyrights.

Examining the legal framework of the digital platform economy with a CTT perspective suggests that it is a crucial aspect to guarantee that digital platforms function in a manner that is just, unbiased, and enduring for all involved parties. CTT focuses on the structural and systemic issues of technology and how they affect power relations, social justice, and democracy. Legislation hereby serves to manage and govern the influence and authority of digital platforms, which can produce significant effects on individuals, groups, and the wider society. For example, data privacy legislation can protect individuals from the exploitation of their personal data by digital platforms, while competition laws can prevent dominant players from engaging in anti-competitive practices that limit innovation and harm smaller competitors. CTT also emphasizes the need for legislation that is responsive to the changing dynamics of the digital platform economy. For example, legislation that addresses the unique challenges posed by the gig economy (Bulian, 2021: 106-119; Ostoj, 2021: 451-462) and the platform work can ensure that workers receive fair pay, benefits, and protections. Similarly, legislation that regulates the specific use of algorithms in decision-making processes can help prevent algorithmic bias (cf. Kordzadeh/Ghasemaghaei, 2021: 1-22; Aysolmaz et al., 2020; Baer, 2019) and discrimination.

5.4.1.2 Antitrust and Competition Law to Ensure Level Playing Fields

Competition law and regulations are designed to maintain a balanced market by promoting equitable competition and preventing practices that could impede competition. In the digital platform economy, competition law is crucial to protect consumers and promote innovation by preventing dominant companies from abusing their market power to the detriment of smaller competitors. With the rise of digital platforms, concerns have been raised about the potential for these platforms to engage in anti-competitive behavior, such as using their market power to exclude competitors or favor their own products and services. Competition law is essential to address these concerns and maintain a healthy and competitive digital ecosystem. In addition to traditional competition law, there have been calls for new rules and regulations specific to

the digital platform economy, to address, e.g., the need for an abundance of transparency in relation to algorithms and data usage to prevent discrimination, while also demanding for greater scrutiny of M&A involving digital platforms, particularly those that harm competition and innovation.

A question that can be raised from a competition law perspective (cf. Lundqvist, 2022) is whether platforms must grant access to specific online services to competitors and other companies. This includes access to property rights like software patents, entrepreneurial services like search algorithms, interfaces, and user data. The question is whether these platforms are acting as gatekeepers, forcing other companies to rely on shared services to operate in a market, and whether the platform gives preference to its own services. This transfer of market power to neighboring markets is a transfer of principles of the essential facility from network industries to digital ecosystems. Digital ecosystems of internet platforms are different from physical network industries in that regard. It is crucial to respect the requirement of non-discrimination in the digital economy, particularly regarding owned and operated services like general search engines. An instance of importance is the examination of search algorithms for impartial access, yet it can be arduous to assess the degree of the association between the search engine and website quality. Although search engines require discretion in relevance criteria based on user preferences, this should not be an excuse for misuse.

The last several years have seen a wave of renewed interest in competition law, and several significant changes and efforts around the world. The level of scrutiny on large technology firms has grown significantly in recent years, as there is mounting anxiety globally about the market dominance of technology giants (Investopedia, 2021; WCCF Tech, 2022), including Alphabet, Amazon, and Meta. This has resulted in several inquiries and legal actions against these firms for purportedly engaging in anticompetitive behaviors, such as impeding competition and monopolizing markets. Many countries have updated their merger control laws (Jones Day, 2022) to be more stringent, requiring greater scrutiny of M&A, and increasing the penalties for companies that violate these rules, with a focus on preventing mergers that harm competition, especially in markets where there are only a few players (OECD, 2021).

There has been a trend towards increased international cooperation among competition authorities (OECD, n.d.), with greater sharing of information and coordination of investigations, driven in part by the global nature of many markets and the need for cooperation to effectively address anticompetitive practices. In relation to digital markets, there has been a growing recognition of the unique challenges posed by them, which can be highly concentrated and prone to network effects, so that competition authorities have been exploring novel methods to tackle these issues, including employing data and algorithmic analysis. Finally, there has been a shift towards active enforcement of competition law, with greater use of fines, remedies, and other penalties, to send a strong signal to companies that such practices will not be tolerated.

An example for the latter can be found in Alphabet, which has been fined in France for violating the country's competition laws. Specifically, in December 2019, the French Competition Authority found that Google had failed to negotiate in good faith with publishers over the use of their news content on Google's platforms, as required by a new EU copyright law. The French regulator ordered Google to negotiate with publishers within three months or face daily fines of up to €900k (about $1.1m) (Tayar/El Khanchoufi, 2022: 355–359). In April 2020, several French news organizations complained that Google was still not complying with the regulator's order, and in July 2020, the French Competition Authority issued an interim order requiring Google to negotiate with publishers in good faith or face additional fines of up to 900k euros per day. Then it imposed a fine of €500m (about $593m) on Google in July 2021 for failure to comply with the orders related to copyright law. (Euro News, 2021). The regulator found that Google had not provided publishers with enough information about how it was using their content and had not properly negotiated over the use of content on Google's platforms. The fine is one of the largest ever imposed by the French Competition Authority.

In August 2021, the Korea Fair Trade Commission fined the company KRW 207b (approximately $176m) for abusing its dominant market position in the mobile OS market (Reuters, 2021). Taken as a whole, these changes underscore an increasing awareness of the significance of antitrust legislation in boosting innovation, safeguarding the welfare of consumers, and promoting economic expansion, and a dedication to better implementation of these regulations.

5.4.1.3 Copyright Laws to Protect Creators and Their Intellectual Property

Copyright laws play a critical role in regulating the digital platform economy, as they provide legal protection to creators of original works, including literary, artistic, musical, and other creative expressions. Shielding copyrighted works is essential to motivate inventiveness, novelty, and capital investment in producing and dispensing copyrighted works, which adds to the expansion of the digital industry. It also aids in balancing the rights of copyright owners and users by providing exclusions and restrictions to the exclusive rights of copyright owners, such as fair use, which permits the use of copyrighted works in specific circumstances without seeking authorization or making a payment.

The digital platform economy has posed unprecedented challenges to copyright law, as the ease of duplicating and circulating digital works online has made it tough to impose copyright laws and safeguard the rights of copyright owners. Digital platforms, including social media, search engines, and content-sharing platforms, have become the primary means of distributing and accessing copyrighted works and IP, leading to concerns about the impact of platforms on creative industries and fair compensation of copyright owners. To address these challenges, copyright laws have been adapted to the digital environment, including through the introduction of new exclusive

rights for copyright holders and limitations on the liability of digital platforms for infringing content posted by users. Additionally, technological solutions (e.g., DRM systems, content recognition technologies), have been developed to aid in the identification and protection of copyrighted works online.

In the US, the Communications Decency Act of 1996 (Jeweler, 2008) created a paradigm not only for copyright, but for third party content in general by placing platforms as not responsible for them. In terms of copyright specifically, the main law on the subject in the country, the Digital Millennium Copyright Act (DMCA, Rockman, 2004), addresses copyright infringement occurring online. The DMCA provides so-called safe harbor provisions that protect online service providers from being held liable for copyright infringement committed by their users if they meet certain conditions. These conditions include promptly removing infringing material once they are notified of its existence by the copyright owner. The law renders it illegal to circumvent DRM technologies that are used to protect copyrighted works and establishes a process for copyright owners to request that online service providers remove infringing material from their websites. The copyright owner must provide a notice that specifies the infringing material and provides contact information for the copyright owner. In May 2021, the US Copyright Office issued a report recommending that Congress revise the Digital Millennium Copyright Act (DMCA) to address the challenges of online infringement (Gibson, Dunn & Crutcher LLP., 2021).

Between 2018 and 2019, the EU approved a reform of its copyright directive with important impacts on digital platforms and victories for media carriers and content producers, or content publishers. In its articles 15 and 17, the new rule establishes the responsibility of intermediaries for the published content, and the obligation to implement mechanisms to inspect and remove publications that infringe copyrights, which includes both cultural works and journalistic texts from media (Ferri, 2020). Platforms (called information society services, or ISS) can purchase work licenses, thus avoiding accountability. Article 15 (previously Article 11) of the EU Copyright Directive, also known as the link tax or neighboring right, grants press publishers the right to demand payment for the use of their news articles on online platforms. Specifically, online platforms must obtain a license from the publisher to display or link to their articles, and publishers can request payment for that use (Ferri, 2020). This article seeks to assist news publishers in obtaining a more equitable portion of the revenue generated by online platforms through the utilization of their content.

Article 17 (previously Article 13) of the EU Copyright Directive, also known as the upload filter, requires online platforms to take measures to prevent the uploading and sharing of copyrighted content without permission. Specifically, online platforms are required to implement content recognition technologies, such as upload filters, to scan user-uploaded content for copyrighted material, and to block the upload if the content is found to be infringing (Metzger et al., 2020). The aim of this specific article is to help protect the rights of copyright holders and to prevent the widespread use of copyrighted material without permission on online platforms. In March 2019, the EU passed the

Copyright Directive, the standard, however, has yet to complete some steps for its final implementation by European countries and will likely look different in each case, given that it is just a Directive on Copyright in the Digital Single Market, rather than a specific guide on implementation (Electronic Frontier Foundation, 2019).

The two articles mentioned have sparked controversy and faced objections from academics, and civil society organizations (Civil Liberties Union for Europe/European Digital Rights, 2017, s/p.), proposing that especially Article 15 may impede freedom of expression and disadvantage smaller online platforms, making it more difficult for users to access news content and limit the ability of search engines and other platforms to display snippets of articles. In addition, it may have unintended consequences, such as encouraging publishers to avoid linking to one another's content. Article 17, meanwhile, has been criticized for potentially stifling creativity and innovation, as it places a significant burden on online platforms to police UGC and obtain licenses for copyrighted material, which could result in over-blocking of content, limiting the ability of users to share and remix copyrighted material for purposes such as criticism, commentary, and parody. However, the articles are also viewed as vital for safeguarding the rights of content producers and promoting a more equitable distribution of earnings between online platforms and content creators. The ultimate impact of these provisions remains to be seen, as they are still being implemented and enforced by EU member states. However, they represent a shift in the way that copyright is regulated in the digital era and are likely to have consequences for the online ecosystem, including the balance between copyright protection and freedom of expression, the role of online platforms in content creation and distribution, and the relationship between traditional and online media.

5.4.1.4 International Legislation Focusing on Data Protection and Privacy

Data protection and privacy law are crucial for the digital platform economy due to the vast amounts of personal data that are generated and processed by these platforms. These regulations grant individuals with different entitlements, including the entitlement to access, rectify, delete, or object to the handling of their personal data. They establish legal frameworks for the collection, use, and sharing of personal data, ensuring that it is done in a transparent and lawful manner, with clear consent obtained from individuals. Additionally, data protection and privacy laws impose obligations on data controllers to implement appropriate technical and organizational measures to eventually protect personal data from unauthorized access, disclosure, or destruction. These laws also provide individuals with various rights, including the right to access, rectify, erase, or object to the processing of their personal data. Compliance with data protection and privacy laws is essential for the digital platform economy to build trust with its users, maintain its reputation, and avoid potential fines and legal actions, and these laws aim to strike a balance between protecting individual privacy rights and enabling innovation and economic growth in the platform economy.

In the US, there is a framework for specific areas or groups, which has distinct laws to regulate them, such as the health sector that is governed by the Health Insurance Portability and Accountability Act (HIPAA) of 1996, the financial services sector that is regulated by the Right to Financial Privacy Act (RFPA), the electronic communications sector that is governed by the Electronics Communication Privacy Act (ECPA) of 1986, and children's privacy, which is regulated by the Children's Online Privacy Protection Act (COPPA) (Electronic Communication Privacy Policy Disclosure, 1999). The HIPAA is a U.S. federal law enacted in 1996 to protect the privacy and security of individuals' health information (Grandison/Bhatti, 2010: 884-888). The law has two main components: The Privacy Rule establishes national standards for protecting the privacy of individuals' health information. This guarantees people with specific entitlements, such as the entitlement to obtain their health records and to demand rectification of their information. It also requires covered entities, such as healthcare providers and health plans, to implement reasonable administrative, physical, and technical safeguards to protect the confidentiality and integrity of individuals' health information. The Security Rule establishes national standards for protecting the security of electronic health information.

The RFPA (Right to Financial Privacy Act of 1978, 12USC§§3401-3422) mandates that before government agencies can access a customer's financial records held by financial institutions like banks and credit unions, they must obtain the customer's written consent or a court order. Government agencies must provide notice to the customer before they obtain the financial records, except in certain emergency situations. The notice must also include the identity of the agency seeking the records, the nature of the investigation, and the legal authority for obtaining the records. As such, the RFPA is designed to protect the privacy of individuals' financial information and to ensure that government agencies only access this information with proper legal authority and due process (Boyne, 2018: 299-343).

The ECPA, instead, governs the interception of electronic communications and the privacy of electronic communications and related data (Haul, 2014). The law has three main components (the Wiretap Act, the Stored Communications Act, and the Pen Register and Trap and Trace Devices Act; cf. EPIC, n.d.). The Wiretap Act prohibits the interception of wire, oral, or electronic communications, except in certain limited circumstances such as when a warrant has been obtained or in emergency situations. It also provides for civil and criminal penalties for violations of the law. The Stored Communications Act governs the release of electronic communications and relevant data preserved by service providers not owned by the user, including email and cloud storage providers. It generally requires government agencies to obtain a warrant before accessing stored communications or related data, but there are certain exceptions, such as when the customer has consented to the disclosure or in emergency situations. The Pen Register and Trap and Trace Devices Act regulates the utilization of mechanisms that acquire information on the beginning and end points of electronic communications, such as telephone numbers and IP addresses. It generally requires

government agencies to obtain a court order before using these devices, but there are certain exceptions, such as in emergency situations. The law is designed to protect the privacy of electronic communications and related data while also allowing government agencies to access this information in certain limited circumstances.

Lastly, the COPPA regulates the collection, use, and disclosure of personal information from children under the age of 13 by websites, online services, and mobile apps. COPPA requires website operators and online service providers to provide notice to parents about their information practices and to obtain verifiable parental consent before collecting personal information from children under the age of 13 (Topelson et al., 2013). The law further limits the types of personal information that can be collected from children, such as e.g., name, their address, their email address, and their phone number, and requires website operators and online service providers to take reasonable steps to ensure subsequently that children's personal information is protected and secure. COPPA gives parents the right to review, delete, and refuse the collection of their children's personal information, and provides for civil penalties of up to over $40k per violation.

The California Consumer Privacy Act (CCPA), enacted in June 2018, provides California residents with specific rights concerning their personal information and obliges businesses to disclose information about their data-handling practices. The law that went into effect on January 1, 2020, and applies to businesses that meet certain criteria and collect personal information from California consumers (Mulgund et al., 2021). The European Court of Justice nullified the EU-US Privacy Shield in July 2020, which had facilitated companies' transmission of personal data between the European Union and the United States. The court held that the framework did not adequately safeguard the privacy rights of European citizens.

The main novelty, however, occurred in 2018 when the European Union's General Data Protection Regulation (GDPR.eu., n.d.) entered into force (Hamann, 2018), a comprehensive data protection and privacy law (cf. Ryngaert/Taylor, 2020: 5-9). The GDPR, updated the previous directive, establishing a set of new obligations for those who collect and process data on the continent and for European citizens outside of the continent, such as obtaining consent to obtain data from a holder in requests in a clear and accessible manner, ensuring the right for revocation (Hamann, 2018). The GDPR includes provisions that require companies to notify users in the event of data breaches and to communicate information about how data is processed. Additionally, the GDPR mandates that companies incorporate privacy by design principles in their technology.

The regulations of the GDPR are largely focused on the scope of the law, as it applies to the processing of personal data of individuals in the EU, regardless of the location of the data processing. To process personal data, companies must obtain explicit, specific, informed, and freely given consent from individuals. The GDPR also requires companies to designate a DPO to oversee data protection activities. When it

comes to possible data breaches, companies must notify individuals and data protection authorities of breaches that pose a risk to individuals' rights and freedoms. Individuals possess the privilege to retrieve their personal data and get specified information on how it's being handled, and they can also request to be erased (cf. Kelly/Satola, 2017: 1-64) from the platform. In relation to data portability, individuals have the right to obtain their personal data in a structured, widely accepted, and machine-readable format and can move that data to another controller if necessary. Companies must verify compliance with the GDPR and exhibit evidence of their efforts. Non-compliant companies that violate the GDPR may receive a fine of up to 4% of their global annual revenue or €20m, whichever is higher. These are the key regulations, but the Law is complex and includes many other requirements and provisions that aim to protect data and privacy.

In January 2019, the French data protection authority (Commission nationale de l'informatique et des libertés, CNIL) applied the maximum fine for considering that Google violated GDPR provisions and did not respect the law (CNIL, 2019), first, by not providing users with adequate information about how their data was being collected and used. Specifically, the CNIL found that the company’s privacy policy was too generic and did not clearly explain how the company was using personal data for advertising purposes. Second, the CNIL found it had not obtained valid consent from users for personalized advertising, and that the company was relying on a pre-ticked box to obtain users' consent, which is not allowed under the GDPR. The CNIL also found that the consent form did not provide users with enough information about how their data would be used. The CNIL's fine of about $57m was the first major enforcement action taken under the GDPR since it went into effect in May 2018. In May 2021, the Irish Data Protection Commission fined Facebook €225m for violating EU data protection rules related to transparency and user control over data (Clyde & Co, 2021). Facebook has faced ongoing criticism over the presence of harmful content on its platform, including hate speech, misinformation, and other forms.

In Latin America, Brazil was the nation with the most recent legislation passed, in 2018, with the entry into force in 2020. The General Data Protection Law (LGPD) was inspired by elements of European regulations (TermsFeed, 2021), but with own interpretations (de Souza et al., 2020: 15-25). The LGPD doesn’t have a clear definition for personal data but mirrors the GDPR’s definition. In addition to defining personal data as a person's identifiable records and instituting the category of sensitive data (e.g., race, ethnicity, religion), the Law sets the hypotheses for data processing by companies and public institutions. The former has become more rigid, while the latter has become more adaptable. The law imposed certain duties on the latter, such as safeguarding data, disclosing the purpose of processing, and acquiring the consent of the data subject, among other things. The loopholes for abuse are in the exceptions though, as in the figure of legitimate interest (i.e., when the controller uses the data for a purpose other than that for which it was collected). The law also established users' rights, how to request the data that a company has from them, as well as to whom they

were transferred, and for what purpose. It is also possible to request adjustments if a registration is incorrect, as well as to oppose certain types of treatment. The Law ensured the right to portability (cf. the GDPR regulation in that regard), and specific rules for children, such as granting consent by the guardian. The application of sanctions, such as fines, was delegated in the version approved by Congress, a data protection authority was foreseen, but in a subsequent provisional measure, this was weakened in its independent character and submitted to the federal government. While fines as result of the GDPR are substantial, the fines under the LGPD are less costly, and the maximum fine is 2% of for the prior financial year up to a maximum of $12m.

5.4.1.5 Maintaining Safe Online Environments Through Content Moderation and Deletion

Content moderation and deletion are essential for digital platforms to maintain a safe and productive online environment for users. Digital platforms rely on their ability to regulate and moderate UGC to create a valuable and trustworthy online community. These platforms must balance the need for content moderation with the importance of free expression, as well as addressing issues related to hate speech, harassment, and harmful content. Content moderation involves determining which content violates the ToS and community guidelines and taking action to remove (cf. Kelly/Satola, 2017: 1-64) or limit access to that content. Digital platforms use a variety of tools to moderate content, including automated systems and human review processes. The process is complex and requires consideration of legal and ethical standards, including protection of user privacy, the avoidance of censorship, and the promotion of free expression.

The importance of content moderation and deletion is amplified by the growing influence of digital platforms in shaping public discourse and the spread of information. This could be seen when in the latter part of the 2010s intense debates on the power of digital platforms and their role in spreading misinformation took place, including fake news, which affected many countries worldwide (cf. Flew/Martin, 2022). Social media platforms were accused of enabling the spread of misinformation about the election results, which led to the storming of the US Capitol in 2021. Meta has been accused of not doing enough to prevent spread of hate speech and misinformation during elections in India as an investigation (Newley/Horwitz, 2020) found that Facebook's policies had allowed politicians in India to use the platform to spread hate speech and incite violence against minority groups.

Certain countries established a mixed legal regime where a platform or website may be held liable if it fails to comply with a court order. Neither a private company nor an authority can request the removal of a publication except in cases of non-consensual disclosure of sexual content. However, the law does not prevent application providers from excluding content based on their terms of service or community standards. In May 2018, the European Union introduced the Audiovisual Media Services Directive (Vlassis, 2017: 102-128), which revises regulations for both conventional and online

media, and mandates that video-sharing platforms implement safeguards to prevent users from being exposed to harmful content. In late 2020 and early 2021, new rules were implemented in the US and Germany to combat harmful content online. The US Federal Communications Commission (FCC) mandated internet service providers to block robocalls (Federal Communications Commission, n.d.), while the German Network Enforcement Act (NetzDG, cf. Wagner et al., 2020: 1-13) required social media companies to report illegal content, including hate speech and fake news.

The NetzDG law was subject to international debate due to the obligations it imposed on application providers to inspect and remove illegal content, with fines of up to €20m or 4% of annual global revenue. Some journalists and freedom of expression organizations have criticized the rule, although it includes transparency requirements and mechanisms for notification and appeals. In November 2018, France passed a law that allows judges to order the immediate removal of posts considered fake news during elections. This law requires platforms and other content providers to disclose the resources they received to promote information. Critics of the law argued that it could threaten democracy and censor the press. It's worth emphasizing that there are numerous additional legal and regulatory initiatives in this field that have not been discussed, and these initiatives are continuously developing.

These laws demonstrate how digital platforms are increasingly under pressure to regulate the content that is being published on their websites. To comply with relevant laws, platforms have developed various mechanisms to moderate and remove content that is deemed inappropriate or illegal, including a combination of automated tools and human moderation (Gillespie, 2020). Content can be flagged by users, detected by automated tools, or brought to the attention of moderators through other means. After being marked for review, the content could undergo scrutiny by human evaluators, who hold the discretion to determine whether to delete it or leave it up. This process can be supported by automated tools such as ML algorithms or NLP to identify patterns and classify content. Platforms are also expected to maintain transparency and accountability in their content moderation practices, by publishing reports on content removal and notifying users of the reasons for removal. However, there are concerns about the potential for bias and censorship in content moderation (cf. Jiang, et al. 2020), and the need for a balanced approach between free speech and protection from harmful or illegal content, as mentioned.

5.4.2 Regulatory Intervention, Analysis of Platform Behavior and Abuse of Market Power

5.4.2.1 Legal and Regulatory Intervention to Shape the Behavior of Digital Platforms

Understanding intervention is important as it involves actions taken by governments or other actors to regulate or shape the behavior of platform businesses. Various types of interventions discussed, such as antitrust inquiries, data privacy rules, or content

curation policies, can be implemented to address platform-related issues. The effects of such interventions on the platform economy's competitive environment and the welfare of stakeholders such as workers, consumers, and others can be substantial. Antitrust investigations or break-ups of large tech companies can create opportunities for smaller firms to enter the market, while also promoting innovation and consumer choice. However, such interventions can also disrupt existing business models and reduce incentives for investment and growth. Interventions can also address social and ethical concerns related to the platform economy, such as the spread of misinformation or the use of personal data for targeted advertising.

Without such intervention and regulation, digital platforms may engage in anti-competitive practices that harm consumers and SMBs. Dominant platforms may use their market power to engage in predatory pricing or impose unfair ToS on users. Such practices can result in reduced consumer choice and innovation, as well as harm to competition and long-term economic growth. Digital platforms may also collect and use user data in ways that compromise privacy and security, risking data breaches, surveillance, and other forms of unauthorized access, all risks that erode trust in the digital economy and limit the willingness of individuals and businesses to participate in it.

Antitrust enforcement is a key form of intervention in the digital platform economy and involves government regulators or antitrust authorities taking legal action against companies that are deemed to be engaging in anticompetitive behavior (Mokronosov/Anisimova, 2020). Antitrust laws aim to promote competition and prevent monopolies or oligopolies from arising, which can harm consumers, other businesses, and the overall economy. In recent years, digital platforms have come under increased scrutiny (Investopedia, 2021; WCCF Tech, 2022) for their market power and alleged anticompetitive practices, leading to several high-profile antitrust cases.

One concrete example of intervention in the digital platform economy is the European Commission's (2017) antitrust investigation into Google's business practices. The investigation began in 2010 and lasted for several years, ultimately resulting in a fine of €2.42b in 2017 for breaching EU antitrust rules. The investigation focused on Google's shopping comparison service, which the European Commission found to be promoting Google's own products over those of its competitors, thereby giving it an unfair advantage in the market. In addition to the fine, the European Commission required Google to change its business practices to ensure a more level playing field for competitors in the market. Google was required to give equal treatment to rival comparison shopping services and to display their results in the same way it displayed its own. The company was also required to provide regular reports to the European Commission detailing how it was complying with these requirements. The intervention was carried out via antitrust legislation, which prohibits firms from engaging in activities that suppress competition and harm consumers. The European Commission's intervention aimed to encourage market competition and protect consumer freedom and sovereignty. The effects of the intervention were ambiguous. Although the penalty and the mandate to alter its business practices were intended to boost market competition, it

is uncertain if these actions had a meaningful effect. Google still dominates the search engine market, and its shopping comparison service has not regained market share lost to competitors. However, the intervention did demonstrate that antitrust laws can be used to regulate digital platforms and promote competition in the market.

Another example of intervention in the digital platform economy is the implementation of net neutrality laws (Cheruvalath, 2018), which aim to ensure that internet service providers do not prioritize or discriminate against certain types of internet traffic, helping to ensure that all actors have equal access to information. Following data breaches and concerns over the use of personal data by tech companies, governments have acted by implementing laws like the GDPR and CCPA in the US. The antitrust investigations and lawsuits against large tech companies, which aim to promote competition and prevent monopolistic practices in the digital platform economy, serve as another case of intervention. In 2020, the U.S. Department of Justice filed a lawsuit against Google alleging anticompetitive behavior in its search and advertising business (Department of Justice, 2020), while in the same year the European Commission launched two formal antitrust investigations into Apple's App Store and the company's practices in the music streaming market (The Verge, 2020).

Comprehending the significance of intervention within the digital platform economy elucidates the impact of power dynamics and governance structures on the consequences of technological advancements. Interventions act to even out the interests of diverse stakeholders and guarantee that the rewards of technology are allocated justly and impartially. However, interventions can also have unintended consequences and may require ongoing monitoring and evaluation to ensure their effectiveness. Intervention, as understood in the sense of CTT, involves the introduction of intentional change to the digital platform economy to comprehensively address issues related to power and control. CTT posits that technologies are shaped by societal and economic forces, and in turn, shape those forces and, therefore, must be targeted towards addressing the social and economic implications of technology use in the digital platform economy.

5.4.2.2 Analysis of Market Power and Considerations Prior to Regulation and Intervention

Market power is an important concept especially in antitrust and competition law, as firms with market power may be able to restrict output and raise prices, leading to consumer harm. Determining such market power of digital ecosystems or dominant players, however, is not as straightforward due to their dynamic environment, diverse user groups, and complex market relationships. Market power refers to the ability to increase prices or restrict quantities while entering and closing markets easily and recouping investment costs (cf. Massey, 2000: 309-328). Measuring market power directly is challenging, so an indirect approach can be used, considering several factors specific to each company. Defining relevant markets for market share determination is

also complex, especially for digital ecosystems, as their products are highly customized, and market boundaries are blurred. Competition in the digital platform market is complex and cannot be determined solely by looking at individual markets or market share. Considering the competitive potential of a market and the feasibility of market entry is crucial. Gold/Hogendorn (2015) suggest that when evaluating risks of concentrated ownership in digital platforms, it's important to consider factors like platform symmetry and user behavior. The more indispensable a platform, the greater its influence on the market, leading to lower competition.

There are several measures that can be utilized to determine whether a firm or group of firms has market power. Market share refers to the percentage of total sales in a market that is controlled by a particular firm or group of firms (Wind/Mahajan, 1981: 31-42). A high market share may indicate that a firm has market power, as it may be able to influence the price or quantity of goods / services in the market. Concentration ratios (Ukav, 2017: 1-16) measure the percentage of total sales in a market that is controlled by the largest firms in the market. High concentration ratios may indicate that a few firms have significant market power, as they may be able to restrict output and raise prices. The Herfindahl-Hirschman Index (HHI; cf. McAuliffe, 2015a) is a measure of market concentration that considers the size of all firms in a market, calculated by squaring the market share of each firm and summing these values. A high HHI indicates that a market is highly concentrated and that a few firms have significant market power. Entry barriers are obstacles that prevent new firms from entering a market, with high entry barriers indicating that existing firms have market power, as they may be able to eventually prevent new firms from entering and competing in the market. The pricing behavior of firms in a market can also be used to determine market power, e.g., if a firm can increase its prices without losing a significant number of customers, it may have market power. While each of these measures has its own strengths and weaknesses, they can certainly be utilized in a combination to eventually provide a completer and more comprehensive picture of market power in a particular market.

Despite the many competition procedures carried out in recent times, it appears that global online platforms remain unscathed by them, and competition authorities are struggling to counter the financial might and market influence wielded by the platforms with inadequate tools. The platforms are disregarding rules and paying fines, which, despite being record fines for market power abuse, still pay off for them. Given their market caps (Paul, 2018: 600-608; Galloway, 2017: 3, 7, 267), the preventive influence of penalties is only effective when it is evident in advance which actions constitute wrongdoing. However, due to the emergence of novel entrepreneurial approaches in the platform economy, this is not always the scenario. Public concerns about large digital companies often revolve around issues such as data protection, political influence, and the formation of echo chambers (cf. Bright, 2016). Calls for the break-up of these companies are made, but separating business units across different markets may not necessarily solve the issue of market power in individual markets. While concerns about the economic and political influence of these companies are justified, it is

important not to oversimplify market power. Before considering a drastic measure such as breaking up a company, it must be shown that there is a permanent harmful monopoly with no prospect of competitive forces returning. Other less invasive interventions should also be explored, all while considering the dynamics of platform markets.

In the past, merger control rules played a limited role, but this has changed with large acquisitions that caused fundamental shifts in the business landscape. Evaluating M&A of platforms or networks has become increasingly complex due to network effects, user data, and unpredictable market developments. Competition for users between platforms is frequent, which is characterized by high investments in search-advertising and increasing commissions for providers operating on the platform, making it difficult for providers to escape these mechanisms due to related network effects. Additionally, problems may arise when the platform operator starts operating as a provider on their owned and operated platform, leading to direct competition with other providers who use the platform as clients or partners. Large mergers are often executed to maintain a dominant market position and reduce the likelihood of competitors acquiring strategic assets first. However, such mergers can harm competition as buyers may have reduced incentives to invest in innovations that could compete with their existing products. Determining regulatory issues in mergers involving new companies with significant competitive potential but low sales can be complex, as sales-related thresholds may not be met. Such companies may be better represented by innovative business ideas, data access options, and IP rights rather than sales figures.

In considering the potential abuse of market power, it is crucial to also evaluate the impact of legal intervention and on platform users, including consumers, producers, and the platform itself. One key measure of the impact is consumer welfare, measured in terms of consumer prices, consumer choice, and consumer surplus (McAuliffe, 2015b). Producer surplus refers to the difference between the price producers receive for their goods / services and the minimum price they would be willing to accept (McAuliffe, 2015b). Legal intervention can also impact platform viability, which can be measured in terms of changes in platform revenue, profitability, and market share. Other key considerations pertain to innovation and competition. If there are no viable alternatives, gatekeepers may charge excessive fees for access. Asymmetrical pricing strategies, where one market side subsidizes the other, also need consideration.

High concentration on platform markets is not necessarily a cause for concern if it results in efficiency gains for consumers. A monopoly can even be acceptable if there is competition for the market, and barriers to entry are low, allowing potential competitors to enter the market and compete with established players. In addition to economies of scale and network effects, the reduced possibility to access data can be a significant barrier to entry, particularly in platform markets where data is a key resource. Companies that have been in the market for some time might possess extensive user data that they can exploit to advance their services and gain a competitive edge. In contrast, recent market entrants may not have access to such data and could encounter difficulties in competing. Moreover, data may be utilized as a weapon for

exclusionary behavior, wherein dominant companies prevent access to their data by their competitors or make it complicated for their rivals to use the data, hindering their competition. As a result, regulatory intervention may be necessary to ensure that companies do not misuse their control over data to limit competition.

To understand platform competition, it is therefore important to consider how users behave on platforms, as users often don't change default settings and only look at top search results. Switching platforms can also be hindered by subscription plans (e.g., the Prime subscription bundle) or the image of the platform (e.g., Netflix as the most innovative SVOD offer). Similarly, it's difficult for a long-time seller with a good reputation on one platform to switch to another without an established history. Effective competition doesn't have to come from small newcomers, as large platforms often have overlapping business areas, and competition from other large platforms can prevent abuse. The challenges of analyzing platform markets raise the valid question of how to regulate competition within the digital economy. Due to scalability and concentration, there are significant challenges for competition policy. Entry barriers, dependency relationships, and dual roles of platforms create challenges. However, decreasing concentration may harm consumers. Having a powerful position alone is not a sufficient justification for intervention, and antitrust law does not prohibit monopolies or market power. Nonetheless, there is a prevalent inclination to conflate magnitude with market influence and to require severe courses of action, such as divestiture, to address it.

5.4.2.3 Considerations on Competition and Abuse of Market Power in the Platform Economy

The emergence of platforms has increased competition and made it easier for SMBs to participate. Market power positions can be indicative of high levels of innovation and competitiveness, but they also have the potential for abuse. Parameters that can affect competition include market leverage, price, data exploitation, as well as product or service quality and consumer choice. When evaluating the potential harm that market power positions may cause to consumers, it is crucial to consider the aforementioned factors. The continued usage of online platforms, despite criticisms lodged against them, underscores the need for caution in imposing quick and extreme interventions. It is crucial to scrutinize whether any misconduct would be addressed before implementing drastic measures based on a buildup of allegations.

Additionally, interventions in the platform economy could potentially cause more harm. Successful platform-based business models have emerged predominantly in the US and China, with very few exceptions. Complaints against these platforms often come from countries that have not produced significant competitors themselves. Therefore, regulatory efforts should prioritize creating conditions that foster innovation and promote the founding of start-ups to increase competition rather than solely trying to restrict the business activities of established platforms. Attempts to restrict foreign

players could lead to protectionism and may not stimulate innovation elsewhere. Demands for more competition protection in the face of challenging competition for established industries may be calls for protection against competition through innovative services. Monopolistic markets have also been attributed with higher ability to innovate than competitive markets in some economic literature (e.g., Shapiro, 2012: 361). From a dynamic competition perspective, it's therefore important to consider the role of competition as a driver of innovation.

Innovation is crucial for healthy competition, but it only works if companies can't avoid competitive pressure. If they do, they lose the incentive to innovate, which harms consumers. Online platforms are among the largest investors in R&D, driving technological advancements for several years. Nevertheless, there is a concern that dominant corporations might guide innovation towards their favored business model. This can lead to radical innovations being left unrealized. Therefore, regulations for platforms should focus not only on preventing harmful behavior by powerful companies, but also on improving the conditions for new platform-based companies to emerge. The platform economy presents competition policy, with a crucial challenge, as it necessitates achieving a balance between fostering innovation and competition and avoiding detrimental practices that may harm consumers and rivals. Such a balance demands a subtle strategy that considers the unique features of platform markets, such as network effects, scale-based economies, and one-sided dependencies. Competition regulators must ensure that markets remain open and that entrance to platforms is not unfairly constrained. Meanwhile, they must also address apprehensions concerning data usage, algorithmic influence, and platform content, and the potential for self-referencing and exclusionary conduct by platform operators. Effective competition policy in the platform economy must therefore be forward-looking, flexible, and evidence-based, and should be informed by ongoing dialogue with stakeholders and continuous monitoring of market developments.

Due to the potential for market power abuse in platform markets, competition authorities need to be vigilant. The competition authority should reject the idea of waiving regulatory market power review within the context of abuse control, as it would result in punishing companies for their size rather than their market power. Additionally, media and political moods may influence the perceived extent of market power, so a case-by-case analysis is necessary. It's important to distinguish between abusive behavior and legitimate competitive performance, which can be complex. To avoid being guided by political moods and diffuse feelings, competition law measures should carefully consider the extent of competition damage and its impact on consumers. It is crucial to acknowledge that the displacement of competitors is an inherent consequence of market competition and should not be penalized. Rather than solely focusing on punishing large and powerful platforms, competition policy should prioritize increasing market contestability, protecting consumer choice and sovereignty, and preventing abuse. Powerful platforms should be prohibited from favoring own services without justification, and from engaging in behaviors aimed at preventing multi-platform usage or

switching. It is crucial, therefore, to differentiate between safeguarding healthy competition and safeguarding competitors from it.

Despite a powerful company's current innovative strength, their monopolistic position may make it more tempting for them to use abusive behavior in the future to maintain their dominance. To prevent this, competition authorities should have more power to block powerful platforms from acquiring small innovative startups that could potentially become serious competitors. The importance of data in competition can only be determined on a case-by-case basis, and data availability can be improved through greater legal certainty in cooperation and better provision of data from public authorities. To stimulate competition, it is crucial to ensure that consumers possess the capacity to shift their data to other comparable or supplementary providers. Regulatory interventions should aim to ensure the contestability of markets and protect the freedom of choice and sovereignty of consumers while consistently preventing actual abuse. The focus of these interventions should be to increase transparency on platforms. Additionally, interventions should consider the ambivalent competitive effects of entrepreneurial strategies and aim to allow competitive forces to develop as far as possible.

Competition policy has been actively addressing the challenges posed by digital platforms in recent years, and discussions about further development of the legal framework are ongoing. Given the dynamism and fast pace of platform markets, the complex competitive effects of entrepreneurial strategies, and the popularity of platforms among users, it is wise to exercise caution. However, it would be erroneous to encumber competition policy with non-competitive goals or to subordinate it to an economic policy that prioritizes protectionism. It is important to avoid punishing individual platforms and using uniform measures to address competition issues and other grievances. Although some companies appear to have an irreversible dominance, the field is still relatively young and there is hope for competitive stimulus through fostering new players and technological innovations, such as AI. To increase the chances of success, competition policy should focus on increasing the contestability of markets and protecting the freedom of choice and sovereignty of platform users.

5.4.3 Terms of Service Governing the Relationship Between Digital Platforms and Their Users

Terms of Service (ToS) refer to the legal agreements that users of digital platforms must agree to before accessing the platform's services. ToS are important to understand as they govern the relationship between users and platform providers and are, as such, the rules and regulations that dictate how users can access and use the platform, as well as the rights and responsibilities of platform providers (cf. Shengelia, 2020). The ToS outline what content is acceptable, how personal data is collected and used, and the terms of any financial transactions that take place on the platform. Plat-

form providers are increasingly relying on ToS to protect themselves from legal liabilities and to ensure they can monetize their services. For users, understanding ToS is important as they provide transparency about how personal data is used and what restrictions are in place on content sharing. However, the complex legal language and long documents make it difficult to comprehend the terms users are agreeing to.

By understanding the ToS, policymakers can evaluate the extent to which platforms are fulfilling their obligations and whether additional regulatory measures are necessary. Scholars, instead, can analyze the impact of these terms on user behavior and how they affect power dynamics between platform providers and users. By comprehending the ToS, users can make informed choices about their utilization of online platforms and guarantee that their rights are being safeguarded. Digital platforms use ToS to establish their rights to user-generated content, and to set guidelines for acceptable behavior on their platforms. ToS can have significant impacts on users' privacy, free speech, and access to information, and can lead to controversies, such as when social media platforms remove posts or accounts for violating their guidelines. ToS typically address various matters, including but not limited to privacy concerns, IP, content moderation, and dispute resolution.

As for general platform governance, ToS can outline the rules and guidelines including dispute resolution, user reporting mechanisms, and disciplinary action. Platforms may have different rules for how to report and handle content that violates their ToS, and different penalties for users who violate these rules, or they may also have user councils or other forms of user representation to help guide platform governance. When it comes to IP, the rules and guidelines in the ToS include copyright and trademark issues as well as policies regarding UGC that infringes on the IP rights (e.g., YouTube's Content ID system automatically identifies and flags videos that contain copyrighted material). In relation to data privacy and user rights, ToS can outline how a platform collects, uses, and shares user data. ToS can also outline the user's entitlements relating to their data, including their right to retrieve and remove their information (cf. Kelly/Satola, 2017: 1-64). In 2018, the EU implemented the GDPR, which imposed strict rules on how digital platforms handle user data. This legislation has led to changes in the ToS of many digital platforms to comply with the GDPR requirements. Regarding content moderation and deletion, ToS can outline the rules and guidelines for UGC on a platform, e.g., by prohibiting hate speech, harassment, and other forms of inappropriate content. The enforcement of these rules is carried out by content moderation teams employed by the platform, an area that has come under increased scrutiny, particularly in cases where platforms have been accused of censorship or bias.

By way of example, TikTok is a social media app that allows users to create and share short-form video (Miltsov, 2022: 664-676). As with any social media platform, the TikTok ToS outline the terms and conditions that users must agree on to use the platform, governing everything from how users can create and share content on the app to how their personal data is collected and used by TikTok and its affiliates (TikTok, n.d.a). A fundamental aspect of the TikTok ToS concerns the collection and utilization

of user information, as the platform acquires an extensive array of data from its users, encompassing details on geographic position, device specifications, contacts, and web browsing activity. This data is used to personalize users' experiences on the app, serve targeted ads, and improve the app's overall functionality. For content moderation, TikTok reserves the right to remove any content that violates its Community Guidelines, which prohibit hate speech, harassment, and harmful content. The TikTok ToS also address issues related to IP. Users are required to comply with copyright laws and are not allowed to upload content that infringes on the rights, and TikTok may remove such content violating its IP policies. One of the contentious provisions in TikTok's ToS is the arbitration clause (CLA, 2020), which necessitates that users settle any conflicts with TikTok through binding arbitration instead of the judicial system.

In the Instagram ToS, a significant clause pertains to the ownership of UGC. The provision states that users hold the ownership of their posted photos and videos. However, Instagram is granted a broad license that enables them to use and distribute user content, which includes modifying, creating derivative works, and displaying the content (cf. Levin, 2020: 79-94). This provision has been criticized for potentially allowing Instagram to profit from user content without adequately compensating the original creators (The Guardian, 2020). Like the TikTok ToS, Instagram's ToS permit the collection and utilization of a vast array of user data, comprising data on their whereabouts, device, and engagement on the platform, to tailor content, improve the platform, and offer tailored advertising. These data collection practices may be excessively extensive and unclear to users. Regarding third-party apps and services, the ToS prohibit users from using bots, automated scripts, or other unauthorized third-party tools to interact with the platform, however, limiting the ability of developers to create innovative tools and services that enhance the Instagram experience at the same time. The ToS further prohibit users from posting certain content, such as hate speech, harassment, or nudity, and the app reserves the right to remove or disable content that violates these rules, and to terminate the accounts of users who repeatedly violate ToS.

As part of ToS, community guidelines are rules created by digital platforms to establish standards for user behavior and content on their platforms, to serve as a mechanism to ensure that UGC is within the boundaries of acceptable conduct and can be used without causing harm or offense to others (cf. Wielsch, 2018: 61-94). For example, Facebook's Community Standards prohibit hate speech, harassment, and the sharing of nudity / sexually explicit content. Twitter's Rules prohibit violent threats, hate speech, and the promotion of terrorism. YouTube's Community Guidelines prohibit spam, copyright infringement, and the posting of violent or sexually explicit content. These guidelines also provide clarity to users about the platform's expectations, and the consequences of violating them. Depending on the severity of the violation, digital platforms can take actions like removing content, suspending, or banning users, or reporting illegal activity to law enforcement (cf. Stjernfelt/Lauritzen, 2020: 115-137 on Facebook specifically). In addition, community guidelines also serve to protect the plat-

form from legal liability. Platforms that do not moderate UGC may face legal consequences for hosting harmful or illegal content. By creating and enforcing community guidelines, platforms can demonstrate that they are making reasonable efforts to prevent harmful content from being published on their platform.

TikTok's guidelines (TikTok, n.d.b) are crafted to safeguard that the content available on the platform is secure, uplifting, and suitable for every user, irrespective of their age or background. According to the guidelines, users are not allowed to post any content that contains nudity, pornography, or sexually explicit material. This includes both visual and audio content, as well as comments and messages that contain sexual content. TikTok defines hate speech as any content that attacks or incites violence against an individual or group based on their race, ethnicity, religion, gender, sexual orientation, or other personal characteristics. Harassment is also strictly prohibited, including any behavior that is intended to intimidate, bully, or embarrass another user. The guidelines also prohibit the promotion of dangerous activities, such as drug use or self-harm, and the use of fake identities or impersonation. Users are also not allowed to engage in spamming, phishing, or other types of fraudulent or deceptive behavior. TikTok's Community Guidelines are enforced by a team of moderators who review content on the platform and act against any content that violates the guidelines. Depending on the severity of the violation, this can range from a warning or temporary suspension to a permanent ban from the platform.

From a CTT perspective, ToS can be viewed as a tool used by dominant digital platform companies to exert control over their users and maintain their power in the market. ToS, as legal documents outlining the rules and regulations for platform usage, often include clauses that allow platforms to collect and use user data for their own benefit, restrict user speech and behavior, and limit user agency and autonomy. Platform companies, which hold a monopoly in the market, can dictate the terms of platform usage, and users are forced to accept these terms if they wish to use the platform. This power dynamic creates an environment in which users are treated as passive subjects, while platform companies can act as active agents, controlling and exploiting user behavior and data. ToS can also have negative consequences for marginalized groups, such as minorities and low-income users, as these groups are often more likely to experience discrimination or harassment on digital platforms, limiting their ability to speak out against these injustices. In that sense, ToS agreements should be reexamined and restructured to better protect user agency, autonomy, and privacy, which can be achieved through an increased transparency and user participation in the development of ToS agreements, as well as through the implementation of stronger regulations that limit the power of platform companies to exploit user data and behavior.

5.4.4 Technological Impact on Work and Employment

As digital platforms and automation gain wider adoption, the character of work is swiftly evolving, necessitating reflection on the implications for the employment market

(McKinsey Global Institute, 2017b), income disparity (Keese, 2016: 76-88), and prospects for work (Keese, 2016: 228-246). One of the main reasons so be considered for the importance of understanding the future of work is the potential displacement of jobs by automation and AI (Iot For All, 2023; McKinsey Global Institute, 2017a). As digital platforms become more efficient, traditional jobs may be automated, leading to job losses and reduced employment opportunities, exacerbating income inequality, as those who are unable to adapt to the changing job market may be left behind. Moreover, the gig economy (Bulian, 2021: 106-119; Janadari/Preena, 2020: 1-14; Ostoj, 2021: 451-462), which depends on online platforms for its functioning, poses its unique challenges to employees. While gig work can provide flexibility and autonomy, it is often characterized by low pay, lack of benefits, and limited job security (Gussek/Wiesche, 2021). With the proliferation of gig work, it is crucial to contemplate ways to guarantee equitable and secure conditions for workers. In addition, the future of work may require workers to have different skills and competencies, such as digital literacy and the ability to work remotely, raising questions about how to ensure that workers have access to the necessary training and education to stay competitive on the job.

New technologies' impact on job creation is a significant challenge, both destroying and creating jobs. However, there is a concern about the shortage of qualified workers who can take advantage of new technological solutions and productivity gains (World Bank, 2020: 4, 9). Some suggest there will be a modest scale of job destruction, while others warn of negative impacts (cf. Arntz et al., 2016), as automation and digitization have affected middle-skilled workers at large. As such, technology has brought significant changes to the workplace, including more flexible arrangements. However, these changes have also led to the standardization of behaviors, increased control over work processes, and the elimination of protection mechanisms. Additionally, the use of connected systems and devices has led to a shift in sectors from manual activities to actions that utilize information flows, which has increased the intellectualization of occupations and the expansion of subsumed intellectual work by capital. While some argue that these changes will create new job opportunities, others are more concerned about the suppression of necessary workers to increase profits.

At digital platforms, workflows are typically organized around assembling teams of developers to create the platform and its technical resources. Intellectual work materializes in the form of software, algorithms, and other intelligent solutions created through programming and processing inputs to generate outputs. This specialized work requires e.g., network engineers, software engineers, data scientists, and mathematicians. Platforms provide ways to index and enhance intellectual work that may exist as fragmented segments within a company, through the articulation of both demand and supply. By controlling both the buyers and sellers, mapping relevant territories to perform their services, and accelerating performance through real-time connections between stages, platforms can optimize the supply of services, eliminating barriers and improving performance over time. Apart from the development team, digital

platforms usually have a product management department that is responsible for creating new features and improving the platform's functionality. They are also tasked with analyzing user data and feedback to improve the UX. Customer support departments are responsible for addressing user inquiries and ensuring that the platform functions smoothly. Marketing and sales departments are responsible for promoting the platform and attracting new users, and operations departments ensure that the platform's technical infrastructure is running without interruptions. Finally, there are ancillary workers, often employed as contingent workers with no fixed-term contracts, who perform administrative tasks.

The organization of work at digital platforms has led to modifications in the traditional employment model and has deconstructed the form of fixed employment. Despite the limited and varied definition of platform work, it is feasible to recognize certain features and patterns, as these innovative work models are not captured by official labor-market data collected by governments. Technology has certainly made work more efficient by automating routine tasks, reducing errors, and improving productivity. It also enabled workers to work remotely, increasing flexibility and work-life balance. Meta’s Workplace, for example, is a business communication and collaboration platform designed to provide a secure and private space for teams to work together and communicate, including a variety of features and functionalities (e.g., to create groups based on teams, projects, or interests, to post updates, files, and comments, or hold group chats and video calls). Such improved communication allows workers to communicate in real-time, regardless of their location, even those in different locations internationally. Technology has also made it easier for workers to access information they need for their work. Nevertheless, negative effects include the displacement of jobs as automation takes over certain tasks and led to increased isolation as remote work and reliance on technology decreased social interaction, while leading to a more sedentary lifestyle overall, which can have negative health effects. With the growing amount of work being conducted over the internet, the vulnerability to cyber-attacks and data breaches is on the rise as well.

It is crucial to acknowledge that the gig economy is a nascent phenomenon, and the ramifications of this employment model are not yet comprehensively grasped. However, there are some frequently cited pros and cons of the platform-based business models in the gig economy (cf. Bulian, 2021: 106-119; Janadari/Preena, 2020: 1-14; Ostoj, 2021: 451-462). Gig workers face short-term project-based work without the security of a traditional job and do not receive benefits such as health insurance, paid time off, or retirement benefits, which may lead to financial insecurity and unpredictability of income, as with varying amounts of work available at different times, it is difficult to plan and budget for the future. Also, some countries have regulations that make it difficult for gig workers to obtain protections such as minimum wage laws. In relation to benefits, gig workers have the freedom to decide when and where they work, providing a more favorable work-life balance and increased autonomy. Gig work enables individuals to gain exposure to diverse projects and industries, resulting in personal

and professional growth and possibly lucrative earnings, as skilled workers can earn higher rates compared to typical employees. Many gig jobs do not require extensive education or experience, making it more accessible for people to enter the workforce.

One concrete example of the impact on the digital platform economy is the controversy surrounding the classification of Uber drivers as independent contractors rather than employees (Malos, et al., 2018; Davidov, 2017). In many jurisdictions, including the US and the UK, Uber has faced legal challenges over its classification of drivers (cf. Dudley et al., 2017). In 2020, the California state legislature passed a law that reclassified many gig workers as employees, including Uber and Lyft drivers (Ridester, 2023). Another example is the emergence of worker-led activism and organizing. Digital platform workers have organized protests, strikes, and other forms of collective action to demand better working conditions, higher pay, and greater worker protections. In 2019, Uber and Lyft drivers in the US held a one-day strike to demand better pay and benefits (The Guardian, 2019), while Deliveroo riders in the UK have organized protests over changes to their pay and working conditions (Sky News, 2021). These forms of worker activism highlight the need for greater attention to worker protections and rights in the digital platform economy.

When considering the future of work as described from a CTT perspective, it is a significant area of concern. The emergence of the digital platform economy has given rise to novel forms of labor, including platform work, crowd-work, and gig work. These types of work are largely typified by precarious conditions, minimal compensation, and a dearth of job stability (The New York Times, 2023). The CTT sees these working conditions as indicative of the systemic exploitation, where workers are treated as disposable resources to be used and discarded at will by platform companies. The platform economy prioritizes profits over workers' well-being - as could be observed well when large tech conglomerates laid off thousands of workers in late 2022 and early 2023 (Marr, 2023; CNBC, 2023; TechCrunch, 2023). As such, platform companies are incentivized to cut headcount related costs as much as possible, leading to the growth of precarious and low-paying work. This, in turn, has led to the erosion of traditional labor protections, such as minimum wage laws, benefits, and collective bargaining rights. Algorithms used by digital platforms to match workers and jobs often reproduce and amplify existing social inequalities, such as gender and racial discrimination. The platform companies' claim that they are mere intermediaries between workers and customers obscures their role in shaping work relations and responsibilities.

6 SUMMARY

In recent years, digital platforms have emerged as a powerful force in the global economy, transforming entire industries and markets. These platforms rely on advanced technology and digital components to facilitate their operations, creating new forms of value and convenience for different stakeholders such as consumers, producers, and intermediaries. Digital platforms are defined as online or digital intermediaries that connect buyers and sellers or providers and consumers of goods, services, or information. They use algorithms, data analytics, and other digital technologies to match supply and demand, manage transactions, and foster interactions between users. Examples of digital platforms include e-commerce marketplaces like Alibaba, social media networks like TikTok, on-demand services like Uber, and cloud computing providers like Amazon Web Services.

The ascent of digital platforms has brought about substantial transformations in the dynamics of competition, creativity, and governance across multiple industries. On one hand, digital platforms have disrupted traditional business models and created new opportunities for entrepreneurship, creativity, and efficiency. For example, digital platforms have enabled SMBs and individual sellers to reach global audiences, reduced transaction costs and information asymmetries, and enabled rapid experimentation and iteration of new products and services. On the other hand, digital platforms have also raised concerns about market concentration, data privacy, and work-related rights. Some digital platforms have achieved dominant positions in certain markets, leading to potential antitrust and competition issues. Other platforms have faced criticism for their data collection and usage practices, raising questions about privacy and user autonomy. Moreover, the gig economy model used by many on-demand platforms has been criticized for its potential impact on worker rights and social welfare.

To understand the impact of digital platforms on the economy, a comprehensive literature review of the important technology and components of digital platforms was conducted, as well as their implications for key economic principles such as innovation, disruption, and competition. Innovation (refer to chapter 2.2) is a critical driver of economic growth and prosperity, and digital platforms have been identified as key enablers of innovation in various sectors. The study examined the literature on how digital platforms facilitate innovation by lowering entry barriers, reducing transaction costs, and enabling rapid experimentation and iteration of new products and services. Digital platforms have provided entrepreneurs with the ability to tap into untapped markets and consumers, which has fostered the creation of novel business models and products that were once out of reach. Additionally, these platforms have enabled the exchange of knowledge, expertise, and resources, which has increased cooperation as well as innovation. Disruption (refer to chapter 2.3) is another key economic principle that characterizes the digital platform economy. Digital platforms have disrupted traditional business models and created new forms of value and convenience for consumers and producers. The study reviewed the literature on the disruptive effects and found that digital platforms have facilitated the emergence of new market entrants, reduced

prices, and transaction costs, and enabled the efficient use of underutilized resources, while it also identified challenges associated, such as concerns over the quality and safety of services, the erosion of worker protection, and the concentration of market power. Competition (refer to chapter 2.4) is a fundamental economic principle that ensures efficient allocation of resources and benefits consumers. Digital platforms have raised complex challenges for competition policy, given their potential to create dominant positions and affect market dynamics. The study examined the literature on competition and found that digital platforms exhibit diverse competitive dynamics, depending on their market structure, governance, and ecosystem. Although digital platforms are not created equal, some platforms are more dominant than others, taking advantage of powerful network effects to capture a large portion of the market share in winner-takes-all markets. Conversely, others operate in multi-sided markets, where multiple groups of users are connected, and the platform benefits from their interactions between them. The study identified several strategies for promoting competition in digital markets, such as fostering interoperability, promoting data portability, and enforcing anti-trust regulations.

The analysis approach of this study to comprehensively determine the impact of technology on the digital platform economy has utilized references from the CTT, as discussed in chapter 3. This theory argues that technology is not neutral, but shaped by the economy, social structures, and power relations. As such, the CTT provides a more comprehensive and holistic approach to understanding the impact of technology on society than traditional economic perspectives. While the economic approach focuses on the allocation of resources and the maximization of profits, the CTT seeks to understand the broader societal implications. By examining technology from a critical perspective, the study was able to identify and analyze the ways in which technology can reinforce and perpetuate power imbalances, inequality, and exploitation within the digital platform economy. This approach is particularly relevant in the digital platform economy, where technology is integral to the functioning of the market, and the consequences of technological decisions have significant impacts on the lives of people worldwide. Using the CTT reference framework has the advantage of offering an intricate and thorough approach to evaluate the influence of technology, considering the intricate interconnection between technology, power, and social systems. Nonetheless, a possible disadvantage of this selected method is that it might be challenging to put it into practice. The critical perspective may also be seen as negative or pessimistic and may not provide clear guidance on how to address the challenges. Notwithstanding, CTT continues to be a valuable perspective to scrutinize how technology affects the digital platform economy, notably regarding power dynamics and considerations of social equity.

The ecosystem of the digital platform economy is intricate and depends on a range of technological elements and mechanisms to operate with optimal efficiency and effectiveness. The study conducted a comprehensive review to identify the key technological components of the digital platform economy and to explore their implications for

various stakeholders, such as users, producers, and regulators. Protocols and standards (refer to chapter 4.3) are fundamental to the functioning of digital platforms, enabling the seamless exchange of information and transactions across diverse networks and systems. The investigation revealed that these technological arrangements support compatibility, expandability, and safety. However, the study also revealed several issues linked to the application of regulations and models, such as the shortage of standardization and the danger of becoming fixed. Networks (refer to chapter 4.4) are the backbone of digital platforms, connecting users and devices across diverse locations and contexts. The study found that these enable rapid communication, collaboration, and coordination, but that networks also present risks of congestion, security breaches, and privacy violations. Central processing units (CPUs), as discussed in chapter 4.5, are essential for the operation of PCs and other devices, enabling them to execute instructions and perform computations that support various applications and services, such as VR, ML, and data analysis. Nonetheless, the technology faces inherent challenges, such as the growing demand for computing power and the risks associated with data breaches and cyber-attacks. Mobile devices (refer to chapter 4.6) are ubiquitous in the digital platform economy and provide users with access to a range of services and applications. The study found that they enable new forms of interaction, collaboration, and creativity, but come with a limited battery life, the risk of theft or loss, and the potential for distraction and addiction. The components that allow users and developers to interact with digital platforms are the user-facing and developer-facing components, including applications and API interfaces (as discussed in chapter 4.7). They play a crucial role in providing access to various services and data and thus impact the user experience and developer ecosystem. These present risks of security vulnerabilities, complexity of integration, and the need for constant updates and maintenance. Data collection (refer to chapter 4.8) has been identified as a fundamental aspect of the digital platform economy, enabling the generation, analysis, and use of vast amounts of data. The investigation unveiled that it allows for novel types of customizations, suggestion, and focus on specific audiences, but this is associated with the possibility of invading privacy, lacking transparency, and the chance of being partial and discriminatory. Additionally, the research found that blockchain technology (refer to chapter 4.9) has the capacity to enable fresh methods of distributed, secure transactions and value transfer across different sectors, such as finance, supply chain management, and digital identification. However, the study also identified several challenges associated with the technology, such as scalability issues, regulatory uncertainty, and the risk of centralization. Algorithms, AI, and ML (refer to chapters 4.10 and 4.11) have collectively been identified by the study as the core technologies that enable digital platforms to extract insights, make predictions, and automate various processes, enabling new forms of personalization, efficiency, and innovation. Risks associated are like the ones identified for data collection (bias, misuse, abuse). Lastly, AR/VR (refer to chapter 4.12) are technologies that enable new forms of immersive and interactive experiences in the digital platform economy, presenting the potential to transform in-

dustries (e.g., gaming, education, healthcare), while resulting in the high cost of hardware and software, the limited availability of content and applications, and the potential for social isolation and addiction.

The digital platform economy is characterized by a complex ecosystem of markets and industries (refer to chapters 5.1 and 5.2). The application systems and apps market (refer to chapter 5.2.1) include platforms and marketplaces that enable the distribution and monetization of mobile applications, a market that is highly competitive and dynamic, with new players entering and exiting the market frequently. Keeping pace with these developments matter particularly for app developers, platform operators, and investors to make informed decisions. The e-commerce market (refer to chapter 5.2.2) is a key driver of growth for many platforms, such as Amazon and Alibaba, but the market is prone to privacy and security concerns and to unfair competition among sellers. The study highlights the significance of general website, browser, and search usage (refer to chapter 5.2.3) in understanding user behavior, preferences, and monetization strategies in the digital platform economy. Social networks (refer to chapter 5.2.4) play a vital role in shaping consumer behavior and preferences by facilitating content sharing and user connectivity. Social networks are increasingly becoming a crucial channel for digital advertising. Digital platforms that facilitate matchmaking and provide online marketplaces (as discussed in chapter 5.2.5) are pivotal in driving innovation and competition, connecting buyers and sellers to enable transactions. The digital video market (refer to chapter 5.2.6) and audio market (refer to chapter 5.2.7) refer to the distribution and consumption of video/audio content online, and platforms such as YouTube, Netflix, Spotify, and Apple Music are transforming the traditional media landscape and are creating new opportunities for content creators and advertisers. The market for AI (refer to chapter 5.2.8) has been recognized as expanding rapidly. This technology performs tasks that typically would require human intelligence and is increasingly being integrated into various digital platforms, such as chatbots and recommendation systems, creating new opportunities for innovation and efficiency. The AR/VR and metaverse spaces (refer to chapter 5.2.9) are gaining increasing attention in the digital platform economy, since AR/VR technologies enable immersive and interactive experiences, together building what can be a virtual world that is fully integrated with the physical world, creating new opportunities for growth and innovation.

Upon analysis of these technologies and markets, it becomes apparent that the digital platform economy is dominated by large influential players (refer to chapter 5.3.1) and influenced by diverse forces, where technology is a pivotal factor in all of them. The development of new multi-sided markets (refer to chapter 5.3.2) has been facilitated, which can link disparate groups of users, like purchasers and merchants, promoters and customers, or content generators and viewers. Technology facilitated the creation of platforms that can offer different types of services, such as payment systems, logistics, and customer support that can benefit multiple parties simultaneously. As a result of technology, it has become simpler for digital platforms to draw in and keep users, which is a fundamental component for the prosperity of multi-sided

markets. Network effects (refer to chapter 5.3.3) occur through the use of data and algorithms to optimize user experience, personalize content, and create new forms of engagement, for instance, systems for making suggestions and social networks suggest appropriate content or link users with analogous interests, which can heighten the significance of the platform for all users, making it easier for various groups of users to exchange feedback and information with each other, improving positive feedback loops and network effects. Value exchange (refer to chapter 5.3.4) is facilitated as digital platforms can use data and algorithms to match users with relevant products or services, set prices dynamically, and facilitate transactions in real-time. Technology can help offer new forms of value, such as loyalty programs, rewards, and incentives that can encourage users to engage more deeply with the platform. Moreover, technology can capture and analyze data on user behavior, preferences, and transactions, which can inform the design of new services and business models. The use of cloud computing, AI, and automation allows to scale (refer to chapter 5.3.5) operations rapidly and efficiently, enabling platforms to expand user bases, offer new services, and enter new markets more easily. Technology further reduces costs, improve efficiency, and optimize performance, which can enhance platforms' scalability and competitiveness. Digital platforms rely on data (refer to chapter 5.3.6) to create value, optimize their operations, and generate revenue. Technology has enabled platforms to collect and, subsequently, process vast amounts of data on user behavior, preferences, and interactions, which can be used to personalize content, improve recommendations, and target advertising more effectively. However, data exploitation also raises ethical and legal concerns related to user privacy, consent, and control over personal data. Platforms can create and shape ecosystems (refer to chapter 5.3.7) that involve multiple stakeholders, such as developers, partners, and regulators. Technology can enable platforms to provide tools, resources, and incentives that can attract and support ecosystem participants (e.g., APIs, SDKs, revenue sharing). Finally, platforms can dominate markets, resulting in concentration (refer to chapter 5.3.8), by leveraging network effects, economies of scale, and data advantages. Technology has enabled platforms to expand rapidly, enter new markets, and offer new services, which can lead to concentration and reduced competition, which raises concerns related to market power, consumer protection, and innovation.

In conclusion, the study demonstrates that technology is a critical factor in shaping the dynamics of the digital platform economy. Nevertheless, downstream societal consequences arise during these dynamics, in particular, legislation and intervention, platform ToS, and the future of work are key areas that require careful consideration. Digital platforms operate in a rapidly evolving technological landscape and often cross-national borders, making it difficult to enforce existing laws (refer to chapter 5.4.1). Therefore, there is a clear need for fresh legislation and interventions (as discussed in chapter 5.4.2) to guarantee that digital platforms function in an equitable and moral way. This can include areas such as privacy protection, data ownership, and antitrust regulation. In this respect, technology can contribute significantly. The use of block-

chain technology can aid in building distributed networks for data management, control, and ownership, while AI can be employed to recognize and impede any activities that hinder competition. The ToS of a platform (as discussed in chapter 5.4.3) dictate the regulations that govern the interactions between the platform and its users, including matters related to user rights, data gathering and utilization, and content regulation. Hereby, technologies such as NLP can be used to identify inappropriate content, and ML to personalize user experiences. Platforms have created new opportunities for flexible and remote work (refer to chapter 5.4.4); however, the adoption of digital platforms has caused a decline in job stability and the depletion of conventional employment safeguards. Digital platforms utilize AI for job matching, and decentralized work marketplaces are created using blockchain technology.

The assessment offered by the study examined the impact of these technologies on the digital platform economy through the lens of CTT. In brief, and as demonstrated throughout the study, technology significantly influences the digital platform economy, not only in terms of power dynamics within the industry but also in its effects on society. In the digital platform economy, technology is shaped by the business models of platform companies, the preferences and behaviors of users, and the regulatory frameworks that govern these platforms. Data is a key resource that is used to power algorithms, target advertising, and make decisions about users, and the questions need to be raised in which ways data is collected, who has access to it, and how it is used, including consideration of issues related to privacy and the use of data to perpetuate inequality and discrimination. Platform companies further rely on gig workers who operate as independent contractors rather than employees, which has led to concerns about job insecurity, low pay, and lack of benefits.

Drawing from the assessment of technology's influence on the digital platform economy, it is apparent that several significant changes and trends will steer the future of this industry. Among these are technological innovations, consumer preferences that shift over time, developing business models, and modifications to regulations and legal frameworks. AI and blockchain are expected to cause a seismic shift in the development, deployment, and utilization of platforms. The integration of AI can potentially offer bespoke and nimble services to users, while blockchain-backed platforms may provide enhanced security measures and greater transparency. One noteworthy development in the digital economy is the growing prevalence of prominent platforms that hold a considerable advantage owing to network effects, economies of scale, and their ability to accumulate and analyze copious amounts of user data, granting them significant leverage over the markets in which they operate. The aggregation of power in the hands of a few large players in the digital platform economy is improbable to diminish, despite the augmented regulatory examination of the sector. Authorities and governing bodies could endeavor to enforce more stringent regulations concerning the accumulation and utilization of user data, foster rivalry, and guarantee that platforms operate in a manner that aligns with social and ecological objectives. If the metaverse comes to full development, a blurring of boundaries between different types of platforms might

be observable, as well as between the digital and physical worlds, combining elements of VR and AR into immersive and interactive digital environments. Finally, the future of the digital platform economy is likely to be shaped by changing consumer behavior and evolving business models. Overall, the future of the digital platform economy is likely to be shaped by a complex interplay of technological, economic, political, and social factors. It is clear, however, that the impact of the digital platform economy on society is likely to continue to be significant, and that there will be ongoing debates and discussions about the best ways to promote innovation, competition, and social and environmental goals in this rapidly evolving space.

By way of summary, to comprehensively examine the influence of technology on the digital platform economy, this study carried out a thorough investigation of essential technologies and components that comprise digital platforms. It examined the technical architecture, ecosystem dynamics, and regulatory frameworks of digital platforms, as well as their implications for different stakeholders. The examination revealed that the technological aspects of digital platforms, including their algorithms, data analysis, and AI, are vital for facilitating seamless matching and transaction processing. These technologies allow platforms to handle vast quantities of data, optimize user experiences in real-time, and enhance overall efficiency. However, the study has also noted that the reliance on these technologies creates potential risks for bias, discrimination, and manipulation, which must be carefully monitored and regulated. The study also highlighted the importance of ecosystem dynamics in shaping the success and sustainability of digital platforms. The platform ecosystem encompasses various actors such as users, developers, regulators, and companies that sell product or service that complement digital platforms, and their interactions can influence the platform's growth and innovation potential. The study identified several key factors that affect ecosystem dynamics, such as network effects, multi-sided pricing, and platform openness, and suggested strategies for managing these factors to achieve better outcomes. Finally, the study discussed regulatory challenges and opportunities of digital platforms, noting that the regulation of digital platforms is a complex area, requiring careful consideration of various factors such as market structure, user behavior, and innovation incentives. The study listed several policy options for regulating digital platforms, including antitrust enforcement, data privacy protection, and platform governance frameworks. As such, the study provides valuable insights into important technology and components of digital platforms and their impact on the digital platform economy.

From a critical perspective, the study has a shortcoming in that it offers a broad view on the digital platform economy, instead of delving into specific platforms or markets in a more detailed manner. This means that the analysis may miss nuances and complexities that are unique to certain contexts. Additionally, the study primarily relies on existing literature rather than original data collection or empirical research, which can limit the depth and specificity of the analysis. Another limitation is that the study focuses on the current state of the digital platform economy, without necessarily projecting how it may evolve or change in the future. Due to the swift advancement of

technology and the likelihood of significant market and consumer behavior changes, the trends presented in the study could become obsolete or inconsequential in the future. Therefore, future research would benefit from focusing on precise and specialized studies of individual technologies, markets, or platforms in the digital platform economy. This could involve more qualitative research, such as specific case studies or interviews with industry experts, as well as more quantitative research to track trends and patterns over time. Sustained inquiry into the moral and societal repercussions of the digital platform economy is crucial, particularly concerning matters such as the confidentiality of information, safeguarding of data, and labor entitlements. While the study provides a valuable analysis of the digital platform economy and its key components and dynamics, there is still much more to be explored and understood in this fascinating area.

7 REFERENCES

Abernathy, W. J., & Clark, K. B. (1985). Innovation: Mapping the winds of creative destruction. ScienceDirect, Elsevier, Research Policy, 14(1).

Accenture Technology Vision. (2022). Meet Me in the Metaverse. Accenture.

Adamopoulou, E., & Moussiades, L. (2020). Chatbots: History, technology, and applications. Machine Learning with Applications, 2.

Adebayo, K.S. (2022). Meta describes how AI will unlock the metaverse. VentureBeat. Retrieved Apr. 7, 2023, from https://venturebeat.com/technology/meta-describes-how-ai-will-unlock-the-metaverse/.

Adjabi, I., Ouahabi, A., Benzaoui, A., & Taleb-Ahmed, A. (2020). Past, Present, and Future of Face Recognition: A Review. Electronics, 9(8), 1188.

Adner, R. (2002). When Are Technologies Disruptive? A Demand-Based View of Emergence of Competition. Strategic Management Journal, 23(8).

Adner, R., & Zemsky, P. (2005). Disruptive Technologies and the Emergence of Competition. RAND Journal of Economics, 36(2), 229-254.

Adorno, T. W., Frenkel-Brunswik, E., Levinson, D. J., & Sanford, R. N. (1950). The authoritarian personality. Harper and Brothers.

Agarwal, N. & Steinmetz, R. (2019). Sharing Economy: A Systematic Literature Review, International Journal of Innovation and Technology Management, 16.

Agarwal, S., Agarwal, B., & Gupta, R. (2022). Chatbots and virtual assistants: a bibliometric analysis. Library Hi Tech, 40.

Ahmed, K. M. U., Bollen, M., & Alvarez, M. (2021). A Review of Data Centers Energy Consumption And Reliability Modeling. IEEE Access.

AI Business. (2022). Meta, Microsoft Partner as Metaverse Pivots to Business. AI Business. Retrieved on 15 Dec. 2022, from https://aibusiness.com/verticals/meta-connect-2022-meta-microsoft-partner-as-metaverse-pivots-to-business.

Aisera. (n.d.). Conversational AI: Data-driven, predictive AI chatbots. Aisera. Retrieved on 3 Jan. 3, 2023, from https://aisera.com/chatbots-virtual-assistants-conversational-ai/?utm_source=email&utm_medium=share.

Al-Madhagy, T.-H., Alanzi, A., Mohd Yusof, S., & Alruwaili, M. (2021). Software as a Service (SaaS) Cloud Computing: An Empirical Investigation on University Students' Perception. Interdisciplinary Journal of Information, Knowledge, and Management, 16, 213-253.

Alexa Internet Database. (2020). The top 500 sites on the web. Alexa. Retrieved on 14 Jul. 2022, https://www.alexa.com/topsites.

Aljabr, A., Sharma, A., & Kumar, K. (2019). Mining Process in Cryptocurrency Using Blockchain Technology: Bitcoin as a Case Study. Journal of Computational and Theoretical Nanoscience, 16, 4293-4298.

Alshamsi, M., Al-Emran, M., & Shaalan, K. (2022). A Systematic Review on Blockchain Adoption. Applied Sciences, 12.

Amiri, M. J., Agrawal, D., & Abbadi, A. (2021). Permissioned Blockchains: Properties, Techniques and Applications.

Amit, R., & Schoemaker, P. J. (1993). Strategic Assets and Organizational Rent. Strategic Management Journal, 14(1), 33-46.

Anderson, P., & Tushman, M. L. (1986). Technological Discontinuities and Organizational Environments. Administrative Science Quarterly, 31(3).

Andrews, K. R. (1980). The Concept of Corporate Strategy. New York: Richard D. Irwin.

Arnsperger, C. and Varoufakis, Y. (2006). What Is Neoclassical Economics? The three axioms responsible for its theoretical oeuvre, practical irrelevance and, thus, discursive power. Panoeconomicus, 53, 5-18.

Apigee. (n.d.). Developing with Apigee Edge. Retrieved on 3 Mar. 2022, from https://docs.apigee.com/api-platform/fundamentals/developing-apigee-edge.

AppBrain (2020) Android and Google Play statistics. Retrieved on 14 Sep. 2022, from https://www.appbrain.com/stats.

Arevalo, T. (2020). 20+ Lyft Statistics Rides, Market Share, and Revenue (2020 Edition), (Online), CarSurance. Retrieved on 14 Jun. 2022, from https://carsurance.net/blog/lyft-statistics/.

Arnold, F. (2012). Der Unordnungspolitiker - Lernen von Joseph Schumpeter. Retrieved on 14 Nov. 2022, from http://www.spiegel.de/wirtschaft/oekonom-joseph-schumpeter-und-der-prozess-der-schoepferischen-zerstoerung-a-823853.html.

Aysolmaz, B., İren, D., & Dau, N. (2020). Preventing Algorithmic Bias in the Development of Algorithmic Decision-Making Systems: A Delphi Study.

Arthur, B.W. (1989). Competing Technologies, Increasing Returns, and Lock-In by Historical Events. The Economic Journal, v.99, n.394, 116-131.

Baer, T. (2019). Understand, Manage, and Prevent Algorithmic Bias, A Guide for Business Users and Data Scientists. Apress.

Baidu. (n.d.). Company Overview. Baidu Investor Relations. Retrieved on 3 Jan. 2023, from https://ir.baidu.com/company-overview.

Bailey, J., Steeves, V., Burkell, J. & Regan, P. (2013). Negotiating With Gender Stereotypes on Social Networking Sites From Bicycle Face to Facebook. Journal of Communication Inquiry, v.37, n.2.

Bain, J. S. (1959). Industrial Organization. John Wiley & Sons Inc.

Bain, P. (2019). 10 Need to Know Facebook Marketing Stats for 2019. Social Media Today. Retrieved on 14 Jan. 2023, from https://www.socialmediatoday.com/news/10-need-to-know-facebook-marketing-stats-for-2019/547488/.

Balis, J. (2022). How Brands Can Enter the Metaverse. Harvard Business Review. Retrieved on 31 Jan. 2022, from https://hbr.org/2022/01/how-brands-can-enter-the-metaverse.

Ball, M. (2019). Fortnite Is the Future, but Probably Not for the Reasons You Think. matthew-ball.vc. Retrieved on 14 May 2022, from https://www.matthewball.vc/all/fornite.

Ball, M. (2020). The Metaverse: What It Is, Where to Find it, and Who Will Build It. matthew-ball.vc. Retrieved on 14 Mar. 2022, from https://www.matthew-ball.vc/all/themetaverse.

Ball, M. (2021a). The Metaverse Primer. matthewball.vc. Retrieved on 14 May 2022, from https://www.matthewball.vc/.

Ball, M. (2021b). Ball-Metaverse-Research-Partners, Ballmetaverse. ballmetaverse.co/. Retrieved on 24 Sep. 2022, from https://ballmetaverse.co/.

Ball, M. (2021c). Payments, Payment Rails, and Blockchains, and the Metaverse. MatthewBall.vc. Retrieved on 14 Dec. 2022, from https://www.matthew-ball.vc/all/metaversepayments.

BankMyCell. (2022). How Many Phones Are in the World? BankMyCell. Retrieved on 5 Mar. 2022, from https://www.bankmycell.com/blog/how-many-phones-are-in-the-world.

Barabási, A.-L. (2010). Introduction. In Z. Papacharissi (Ed.), A Networked Self - Identity, Community, and Culture on Social Network Sites. New York: Routledge.

Barbieri, G. (2018). What San Francisco & Silicon Valley should learn from the Medici and the Florentine Renaissance. Medium. Retrieved on 1 Sep. 2020, from https://medium.com/@ciaogiova/san-francisco-silicon-valley-and-the-florentine-renaissance-is-history-going-to-repeat-itself-2fc93ee43665.

Barney, J. B. (1986). Strategic Factor Markets: Expectations, Luck, and Business Strategy. Management Science, 32(10), 1231-1241.

Barney, J. B. (1991). Firm Resources and Sustained Competitive Advantage. Journal of Management, 17(1), 99-120.

Barney, J. B. (1997). Gaining and sustaining competitive advantage. Reading, Massachusetts: Addison-Wesley Publishing Company.

Beasley, M. (2013). A/B Testing. In Risk Intelligence (201-207). Elsevier.

Bekalu, M. A., McCloud, R., & Viswanath, K. (2019). Association of Social Media Use With Social Well-Being, Positive Mental Health, and Self-Rated Health: Disentangling Routine Use From Emotional Connection to Use. Health Education & Behavior, 46(1), 69-80.

Benlachmi, Y., & Hasnaoui, M. (2021). Open Source Big Data Platforms and Tools: An Analysis. Indonesian Journal of Electrical Engineering and Informatics (IJEEI), 9.

Bentaleb, O., Belloum, A., Sebaa, A., & El-Maouhab, A. (2022). Containerization technologies: taxonomies, applications and challenges. The Journal of Supercomputing, 78, 1-26.

Bergvall-Kåreborn, B., & Howcroft, D. (2013). The Apple business model: Crowdsourcing mobile applications. Accounting Forum, 37, 280-289.

Betker, M. R., Fernando, J. S., & Whalen, S. P. (2002). The history of the microprocessor. Bell Labs Technical Journal, 7(3), 11-32.

Bhasin, K. (2012). This is the Difference between 'Invention' and 'Innovation'. Retrieved on 14 Feb. 2020, from http://www.businessinsider.com/this-is-the-difference-between-invention-and-innovation-2012-4?IR=T.

Bhatt, S. (2018). Reinforcement Learning 101. Towards Data Science. Retrieved on 15 Jun. 2022, from https://towardsdatascience.com/reinforcement-learning-101-e24b50e1d292.

Bhawsar, P., & Chattopadhyay, U. (2015). Competitiveness: Review, Reflections and Directions. Global Business Review, 16, 665-679.

Birje, M., Challagidad, P., Goudar, R. H., & Tapale, M. (2017). Cloud computing review: Concepts, technology, challenges and security. International Journal of Cloud Computing, 6, 32.

Bitmovin. (2022). X86 to ARM: AMD vs. ARM vs. Intel. Retrieved on 28 Feb. 2022, from https://bitmovin.com/x86-to-arm-amd-vs-arm-vs-intel/.

Bloomberg. (2021). Why Amazon, Google, Microsoft Are Designing Their Own Chips. Bloomberg.com. Retrieved on 3 Jan. 2023, from https://www.bloomberg.com/news/articles/2021-03-17/why-amazon-amzn-google-googl-microsoft-msft-are-designing-own-chips.

Bobier, M., Mérey, T., Robnett, S., Grebe, M., Feng, J., Rehberg, B., Woolsey, K., Hazan, J.-F., Tibor, J., Stephen, M., Michael, B., Jimmy, G., Benjamin, R., Kristi, W., & Joël, H. (2022). The Corporate Hitchhiker’s Guide to the Metaverse. BCG.

Bodur, H., Klein, N., & Arora, N. (2014). Online Price Search: Impact of Price Comparison Sites on Offline Price Evaluations. Journal of Retailing, 91.

Bonshor, G. (2023). The Best CPUs. AnandTech. Retrieved 30 Mar. 2023, from https://www.anandtech.com/show/9793/best-cpus.

Bordenave, F., Boros, P. (2022). Comparing AMD EPYC Performance with Intel Xeon in GCP. Percona Database Performance Blog. Retrieved on 5 Dec. 2022, from https://www.percona.com/blog/comparing-amd-epyc-performance-with-intel-xeon-in-gcp/.

Borgmann, A. (1984). Technology and the Character of Contemporary Life. University of Chicago Press.

Bose, R. (2007). Competitive intelligence process and tools for intelligence analysis. Emerald Group Publishing Limited, Vol. 108, No. 4.

Bougrine, H. (2016). The creation of wealth and poverty: Means and ways. London, UK: Routledge, Frontiers of Political Economy.

Bower, J. L., & Christensen, C. M. (1995). Disruptive technologies: Catching the wave. Harvard Business Review, 73(1).

Boyne, S. (2018). Data Protection in the United States. The American Journal of Comparative Law, 66, 299-343.

Bright, J. (2016) Explaining the Emergence of Echo Chambers on Social Media: The Role of Ideology and Extremism, SSRN Electronic Journal.

Brihadiswaran, G. (2021). A performance comparison between C++, Java, and Python. Medium. Retrieved on 12 Feb. 2023, from https://medium.com/swlh/a-performance-comparison-between-c-java-and-python-df3890545f6d.

Briskman, J. (2019). Top AVOD apps in the U.S. for Q1 2019 by downloads. SensorTower. Retrieved on 28 Jul. 2020, from https://sensortower.com/blog/top-avod-apps-in-the-us-q1-2019-downloads.

BroadbandNow. (2020). Google Fiber. Broadband Now. Retrieved 3 Aug. 2020, from https://broadbandnow.com/Google-Fiber.

Brownlee, J. (2019). What Are Generative Adversarial Networks (GANs)? Machine Learning Mastery. Retrieved on 2 May 2022, from https://machinelearningmastery.com/what-are-generative-adversarial-networks-gans/.

Builtin. (2022). AI in Retail & Ecommerce: The Latest Tech Innovations. Builtin. Retrieved on 3 Jan. 2023, from https://builtin.com/artificial-intelligence/ai-retail-ecommerce-tech.

Bulian, L. (2021). The Gig is Up: Who does Gig Economy actually Benefit?. Interdisciplinary Description of Complex Systems, 19(1), 106-119.

Bunge, M. (2007). Philosophy of Science and Technology: A Personal Report. In G. Fløistad (Ed.), Contemporary Philosophy: A New Survey, Vol. 9: Aesthetics and Philosophy of Art. Springer.

Bunge, M. (2014). Philosophical Inputs and Outputs of Technology. In R. C. Scharff & V. Dusek (Eds.), Philosophy of Technology: The Technological Condition - An Anthology. John Wiley & Sons.

Business.com. (n.d.). 10 of the Largest Ecommerce Markets in the World. Retrieved on 12 Feb. 2023, from https://www.business.com/articles/10-of-the-largest-ecommerce-markets-in-the-world-b/.

C Valley Network Solutions. (n.d.). Fiber Optic Cable vs. Coaxial Cable: Which Is Better? Retrieved on 1 Apr. 2023, from https://www.cvalley.net/fiber-optic-cable-vs-coaxial-cable-which-is-better/.

Calantone, R. J., Cavusgil, S. T., & Zhao, Y. (2002). Learning orientation, firm innovation, and firm performance. Industrial Marketing Management, 31(6), Elsevier.

Cao, K., Liu, Y., Meng, G., & Sun, Q. (2020). An Overview on Edge Computing Research. IEEE Access, 1-1.

CERN. (n.d.). A Short History of the Web. CERN. Retrieved on 6 Apr. 2022, from https://home.cern/science/computing/birth-web/short-history-web.

Chavas, J.-P. & Kim, K. (2007). Measurement and Sources of Economies of Scope: A Primal Approach. Journal of Institutional and Theoretical Economics (JITE), 163, 411-427.

Chen, N., Lin, X., Luo, R., & Guanzhong, S. (2021). Business Acquisition Analysis: A Case Study of Disney-Fox Deal.

Cheruvalath, R. (2018). Internet Neutrality: A Battle Between Law and Ethics. International Journal for the Semiotics of Law - Revue internationale de Sémiotique juridique, 31.

Chitrakorn, K. (2021). Are branded virtual worlds the new marketing terrain? Vogue Business - Technology. Retrieved on 9 Mar. 2022, from https://www.voguebusiness.com/technology/are-branded-virtual-worlds-the-new-marketing-terrain.

Christensen, C. M. & Overdorf, M. (2000). Meeting the challenge of disruptive change. Harvard Business Review.

Christensen, C. M. & Raynor, M. E. (2003). The Innovator’s Solution: Creating and Sustaining Successful Growth. Harvard Business School Press.

Christensen, C. M. & Rosenbloom, R. S. (1995). Explaining the attacker’s advantage: Technological paradigms, organizational dynamics, and the value network. Research Policy, 24(2).

Christensen, C. M. (1997). The Innovator's Dilemma: When New Technologies Cause Great Firms to Fail. Harvard Business School Press.

Christensen, C. M. (2002). The Rules of Innovation. MIT Technology Review. Retrieved on 22 Oct. 2020, from https://www.technologyreview.com/2002/06/01/234853/the-rules-of-innovation/.

Christensen, C. M. (2006). The Ongoing Process of Building a Theory of Disruption. Journal of Product Innovation Management, 23(1).

Christensen, C. M., Johnson, M. W., & Rigby, D. K. (2002). Foundations for growth: How to identify and build disruptive new businesses. MIT Sloan Management Review, 43(3).

Christensen, C. M., Raynor, M. E., & McDonald, R. (2015). What is disruptive innovation? Harvard Business Review, 93(12).

Church, E. & Oakley, R. (2018). Etsy and the long-tail: how microenterprises use hyper-differentiation in online handicraft marketplaces. Electronic Commerce Research, 18, 1-21.

Čiutienė, R., & Thattakath, E. W. (2014). Influence of Dynamic Capabilities in Creating Disruptive Innovation. Economics & Business, 26.

Civil Liberties Union for Europe/European Digital Rights (2017). Article 13 Open Letter: Monitoring and Filtering of Internet Content is Unacceptable. Letter to the European Parliament. Retrieved from Liberty, EDRi.

CLA. (2020). TikTok and Copyright. Retrieved on 15 Aug. 2021, from https://www.cla.co.uk/blog/higher-education/tiktok-and-copyright.

Clark, C. (2021). Android vs. iOS Programming Languages: Which One is Better? Back4App Blog. Retrieved on 7 Aug. 2022, from https://blog.back4app.com/android-ios-programming-languages/.

Clements, M. (2004). Direct and Indirect Network Effects: Are They Equivalent? International Journal of Industrial Organization, 22, 633-645.

Cloudflare. (n.d.). How does the Internet work? Retrieved on 26 Feb. 2023, from https://www.cloudflare.com/de-de/learning/network-layer/how-does-the-internet-work/.

Cloudflare. (n.d.). What is DNS? Cloudflare Learning Center. Retrieved on 16 Apr. 2022, from, https://www.cloudflare.com/de-de/learning/dns/what-is-dns/.

Clyde & Co. (2021). Irish data regulator fines WhatsApp €225m for GDPR breach. Retrieved on 4 Jun. 2022, from https://www.clydeco.com/en/insights/2021/09/irish-data-regulator-fines-whatsapp-%E2%82%AC225m-for-gdpr.

CNBC. (2018). Alphabet's GV invests in AI chip start-up SambaNova. Retrieved on 3 Mar. 2023, from https://www.cnbc.com/2018/03/15/alphabets-gv-invests-in-ai-chip-startup-sambanova.html.

CNBC. (2023). Meta lost $13.7 billion on Reality Labs in 2022 after metaverse pivot. Retrieved on 23 Feb. 2023, from https://www.cnbc.com/2023/02/01/meta-lost-13point7-billion-on-reality-labs-in-2022-after-metaverse-pivot.html.

CNBC. (2023). Tech firms MSFT, GOOG, AMZN, SAP are profitable but layoffs continue. Retrieved on 24 Mar. 2023, from https://www.cnbc.com/2023/03/24/tech-firms-msft-goog-amzn-sap-are-profitable-but-layoffs-continue.html.

CNIL (2019). The CNIL's Restricted Committee Imposes a Financial Penalty of 50 Million Euros against Google LLC. CNIL - Commission nationale de l'informatique et des libertés. Retrieved on 9 Feb. 2020, from https://www.cnil.fr/en/cnils-restricted-committee-imposes-financial-penalty-50-million-euros-against-google-llc.

CodeSubmit. (2021). History of Android Operating System. CodeSubmit Blog. Retrieved on 5 Nov. 2022, from https://codesubmit.io/blog/history-of-android-operating-system/.

Computer Hope. (2022). Processor history. Retrieved on 5 Mar. 2022, from https://www.computerhope.com/history/processor.htm.

ComputerWeekly. (n.d.). Secure Sockets Layer (SSL). Retrieved on 6 Jul. 2022, from https://www.computerweekly.com/de/definition/Secure-Sockets-Layer-SSL.

Computerworld. (2021). Evolution of the Apple iPhone. Retrieved on 5 Mar. 2022, from https://www.computerworld.com/article/3692531/evolution-of-apple-iphone.html.

Cranz, A. (2021). Google says there are now 3 billion active Android devices. Retrieved on 25 Feb. 2023, from https://www.theverge.com/2021/5/18/22440813/android-devices-active-number-smartphones-google-2021.

Crossan, M. M. & Apaydin, M. (2010). A Multi-Dimensional Framework of Organizational Innovation: A Systematic Review of the Literature. Journal of Management Studies, 47(6).

Crunchbase (2023). List of Google's 259 Acquisitions, including North and AppSheet. Retrieved on 23 Apr. 2023, from https://www.crunchbase.com/search/acquisitions/field/organizations/num_acquisitions/google.

Crunchbase. (n.d.). AI Companies Acquired by the Big Five. Crunchbase. Retrieved 5 Apr. 2023, from https://www.crunchbase.com/lists/ai-companies-acquired-by-the-big-five/8b2cd454-0faa-4a09-b59f-c92555a9cb0f/acquisitions.

Culliford, E. & Balu, N. (2022). Meta shares sink 20% as Facebook loses daily users for the first time. Reuters. Retrieved on 2 Feb. 2022, from https://www.reuters.com/technology/facebook-owner-meta-forecasts-q1-revenue-below-estimates-2022-02-02/.

Cusumano, M. A., Gawer, A., & Yoffie, D. B. (2019). The Business of Platforms: Strategy in the Age of Digital Competition, Innovation, and Power. Harper Business.

D'Aveni, R., Canger, J. M., & Doyle, J. (1995). Coping with hypercompetition: Utilizing the new 7S's framework (and executive commentary). Academy of Management Executive (1993-2005), 9(3), 45-60.

D'Aveni, R. A. & Gunther, R. E. (1994). Hypercompetition: Managing the Dynamics of Strategic Maneuvering. New York: Free Press.

Damanpour, F. & Evan, W. M. (1984). Organizational Innovation and Performance: The Problem of Organizational Lag. Administrative Science Quarterly, 29(3).

Damanpour, F. & Schneider, M. (2006). Phases of the Adoption of Innovation in Organizations: Effects of Environment, Organization and Top Managers. British Journal of Management, 17(3).

Damanpour, F. (1991). Organizational Innovation: A Meta-Analysis of Effects of Determinants and Moderators. Academy of Management Journal, 34(3).

Damanpour, F., Walker, R. M., & Avellaneda, C. N. (2009). Combinative Effects of Innovation Types and Organizational Performance: A Longitudinal Study of Service Organizations. Journal of Management Studies, 46(4).

Danneels, E. (2004). Disruptive Technology Reconsidered: A Critique and Research Agenda. Journal of Product Innovation Management, 21(4).

Danneels, E. (2006). From the Guest Editor Dialogue on the Effects of Disruptive Technology on Firms and Industries. The Journal of Product Innovation Management, 23(1).

Das, R., & Sandhane, R. (2021). Artificial Intelligence in Cyber Security. Journal of Physics: Conference Series, 1964(4).

Davidov, G. (2017). The Status of Uber Drivers: A Purposive Approach. Spanish Labour Law and Employment Relations Journal, 6.

Davies, R. (2016). Broadband as a Universal Service. EPRS | European Parliamentary Research Service. Members' Research Service.

de Poulpiquet, P. (2017). What is a walled garden? And why it is the strategy of Google, Facebook and Amazon Ads platform? Medium. Retrieved on 7 Nov. 2020, from https://medium.com/mediarithmics-what-is/what-is-a-walled-garden-and-why-it-is-the-strategy-of-google-facebook-and-amazon-ads-platform-296ddeb784b1.

de Souza, J., Abe, J., de Lima, L., & Souza, N. (2020). The Brazilian Law on Personal Data Protection. International Journal of Network Security & Its Applications, 12, 15-25.

Dean, B. (2021). Bienvenido al metaverso. Voz Populi. Retrieved on 9 Nov. 2021, from https://www.estrategiasdeinversion.com/analisis/bolsa-y-mercados/el-experto-opina/bienvenido-al-metaverso-n-489089.

Debord, G. (1970). Society of the Spectacle. Black & Red.

Deloitte. (2022). 2022 Digital media trends, 16th edition: Toward the metaverse.

Department of Justice. (2020). Justice Department Sues Monopolizing Digital Advertising Technologies. Retrieved on 17 Nov. 2020, from https://www.justice.gov/opa/pr/justice-department-sues-google-monopolizing-digital-advertising-technologies.

Dereli, D. (2015). Innovation Management in Global Competition and Competitive Advantage. Procedia - Social and Behavioral Sciences, 195, 1365-1370.

Dewar, R. D., & Dutton, J. E. (1986). The adoption of radical and incremental innovations: An empirical analysis. Management Science, 32(11).

Diallo, S., Herencia, H., Padilla, J., & Tolk, A. (2011). Understanding interoperability. In A. Tolk, L. Jain, & L. Yilmaz (Eds.), Simulation-based case studies in logistics (84-91). Springer.

Dianati, M., Song, I., & Treiber, M. (n.d.). An Introduction to Genetic Algorithms and Evolution Strategies. University of Waterloo. Retrieved on 7 Apr. 2023, from https://uwspace.uwaterloo.ca/handle/10012/4016.

Dierickx, I., & Cool, K. (1989). Asset stock accumulation and sustainability of competitive advantage. Management Science, 35(12), 1504-1513.

Digital Divide Council. (n.d.). What is the digital divide? Retrieved 30 Jan. 2023, from http://www.digitaldividecouncil.com/what-is-the-digital-divide/.

Digital McKinsey. (2019). Driving impact at scale from automation and AI. Digital McKinsey.

Digital Music News. (2017). Music Streaming Now Has 100 Million More Subscribers Than Netflix. Retrieved on 29 Apr. 2018, from https://www.digitalmusicnews.com/2017/01/17/music-streaming-100-million-netflix/.

Dignan, L. (2020). Top cloud providers in 2020: AWS, Microsoft Azure, and Google Cloud, hybrid, SaaS players. ZDNet. Retrieved on 8 Apr. 2020, from https://www.zdnet.com/article/the-top-cloud-providers-of-2020-aws-microsoft-azure-google-cloud-hybrid-saas/.

Dionisio, J. D. N., Burns, W. G., & Gilbert, R. (2013). 3D Virtual Worlds and the Metaverse: Current Status and Future Possibilities. ACM Computing Surveys, 45(3), Article 34.

Dosi, G. (1982). Technological paradigms and technological trajectories: A suggested interpretation of the determinants and directions of technical change. Research Policy, 11(3), ScienceDirect, Elsevier.

Dosi, G., Orsenigo, L., & Sylos-Labini, M. (2005). Technology and the Economy. In N. J. Smelser & R. Swedberg (Eds.), Handbook of Economic Sociology (Princeton, New Jersey & New York: Princeton University Press & Russell Sage

DPR Staff. (2021). Qualcomm Snapdragon 8 Gen 1 mobile platform promises 30% faster graphics, updatable GPU drivers. Digital Photography Review. Retrieved on 30 Mar 2023, from https://www.dpreview.com/news/8057268671/qualcomm-snapdragon-8-gen-2-mobile-platform.

Dudley, G., Banister, D., & Schwanen, T. (2017). The Rise of Uber and Regulating the Disruptive Innovator. The Political Quarterly, 88.

Dushnitsky, G. & Stroube, B. (2021). Low-code entrepreneurship: Shopify and the alternative path to growth. Journal of Business Venturing Insights, 16.

Dutton, W. H. (2013). The Oxford internet handbook. Oxford: Oxford University Press.

EDPS. (2023). Interoperability. European Data Protection Supervisor. Retrieved on 5 Mar. 2023, from https://edps.europa.eu/data-protection/our-work/subjects/interoperability_en.

Eisenhardt, K.M. (1989). Building Theories from Case Study Research, Academy of Management Review, v.14, n.4, (532-550).

Eisenmann, T. R., Parker, G., & van Alstyne, M. (2008). Opening platforms: How, when and why? SSRN Electronic Journal, 08.

Electronic Frontier Foundation. (2019). The European Copyright Directive: What Is It, and Why Has It Drawn More Controversy Than Any Other Directive In EU History? Electronic Frontier Foundation. Retrieved on 4 Mar, 2021, from https://www.eff.org/deeplinks/2019/03/european-copyright-directive-what-it-and-why-has-it-drawn-more-controversy-any.

Ellul, J. (1967). The technological society. Vintage Books, Extensive Underlining Edition.

Emergen Research. (2022). Metaverse Market, By Component (Hardware, Software), By Platform (Desktop, Mobile), By Offering (Virtual Platforms, Asset Marketplace, Avatars, and Financial Services), By Technology, By Application, By End-Use, and By Region Forecast to 2030. Emergen Research.

Encyclopedia Britannica. (2022). Central processing unit. In Encyclopædia Britannica. Retrieved on 5 Feb. 2023, from https://www.britannica.com/technology/central-processing-unit.

Epic Games. (2019). Fortnite and Travis Scott Present: Astronomical. epicgames.com. Retrieved on 20 Nov. 2021, from https://www.epicgames.com/fortnite/en-US/news/astronomical.

Epic Games. (2021a). Announcing a $1 Billion Funding Round to Support Epic's Long-Term Vision for the Metaverse. epicgames.com. Retrieved on 21 Feb. 2022, from https://www.epicgames.com/site/en-US/news/announcing-a-1-billion-funding-round-to-support-epics-long-term-vision-for-the-metaverse.

Epic Games. (2021b). The o2 in Fortnite featuring easy life: Join a musical adventure in Fortnite creative starting June 24! epicgames.com. Retrieved on 14 Sep. 2021, from https://www.epicgames.com/fortnite/en-US/news/the-o2-in-fortnite-featuring-easy-life-join-a-musical-adventure-in-fortnite-creative-starting-june-24.

Epic Games. (2021c). The Crossover: The Nba Arrives in Fortnite. epicgames.com. Retrieved on 1 Mar. 2022, from https://www.epicgames.com/fortnite/en-US/news/the-crossover-the-nba-arrives-in-fortnite.

EPIC. (n.d.). The Electronic Communications Privacy Act. Retrieved on 4 Jun. 2022, from https://epic.org/ecpa/.

ESA. (n.d.). System-On-Chip (SOC) Development. Retrieved on 10 Apr. 2023, from https://www.esa.int/Enabling_Support/Space_Engineering_Technology/Microelectronics/System-On-Chip_SOC_Development.

Esser, K., Hillebrand, W., Messner, D., & Meyer-Stamer, J. (1996). Systemic competitiveness: New governance patterns for industrial development. London: Routledge.

Euro News. (2021). France fines Google €500 million in copyright row with news publishers. Retrieved on 13 Jul. 2021, from Euronews. https://www.euronews.com/next/2021/07/13/france-fines-google-500-million-in-copyright-row-with-news-publishers.

European Commission. (2017). MEMO: Questions and answers on the EU General Data Protection Regulation. Retrieved on 17 Sep. 2019, from https://ec.europa.eu/commission/presscorner/detail/es/MEMO_17_1785.

European Commission. (2017). Mergers: Commission fines Facebook €110 million for providing misleading information about WhatsApp takeover. European Commission. Retrieved on 7 Nov. 2021, from https://ec.europa.eu/commission/presscorner/detail/en/IP_17_1369.

European Commission. (n.d.). EU-US data transfers, retrieved on 7 Apr. 2022, from https://ec.europa.eu/info/law/law-topic/data-protection/international-dimension-data-protection/eu-us-data-transfers_en.

European Council on Foreign Relations. (2020). Europe as a digital sovereignty rulemaker: A superpower in the age of US-China rivalry? Retrieved on 15 Mar. 2021, from https://ecfr.eu/publication/europe_digital_sovereignty_rulemaker_superpower_age_us_china_rivalry/.

Evans, D.S. & Schmalensee, R. (2007). Industrial Organization of Markets with Two-Sided Platforms. Competition Policy International, 3(1).

Evans, D.S. & Schmalensee, R. (2016). Matchmakers: The New Economics of Multisided Platforms. Boston, Harvard Business Review Press.

Evans, D.S., Hagiu, A., & Schmalensee, R. (2016). Invisible Engines: How Software Platforms Drive Innovation and Transform Industries.

Evans, P.C. & Gawer, A. (2016). The Rise of the Platform Enterprise: A Global Survey. New York: The Center for Global Enterprise.

Federal Communications Commission. (n.d.). Spoofed and Robocalls. Retrieved on 12 Apr. 2023, from https://www.fcc.gov/spoofed-robocalls.

Feenberg, A. (1996). Marcuse or Habermas: Two Critiques of Technology. Inquiry: An Interdisciplinary Journal of Philosophy, 39.

Feenberg, A. (1999). Questioning Technology. London: Routledge.

Feenberg, A. (2002). Transforming Technology: A Critical Theory Revisited. New York: Oxford University Press.

Feenberg, A. (2005). Critical Theory of Technology: An Overview. Tailoring Biotechnologies, 1(1).

Feenberg, A. (2017). Critical theory of technology and STS. Thesis Eleven, 138(1).

Feifei, F. (2021). Facebook's 'Meta' move boosts tech firms. China Daily. Retrieved on 21 Mar. 2022, from https://global.chinadaily.com.cn/a/202110/30/WS617c7daba310cdd39bc72394.html.

Ferri, F. (2020). The dark side(s) of the EU Directive on copyright and related rights in the Digital Single Market. China-EU Law Journal, 7.

Fich, M. & Dave, P. (2019). Facebook's flood of languages leave it struggling to monitor content. Reuters. Retrieved on 11 Jul. 2020, from https://www.reuters.com/article/us-facebook-languages-insight/facebooks-flood-of-languages-leave-it-struggling-to-monitor-content-idUSKCN1RZ0DW.

Financely Group. (2022). Introduction to the Metaverse. Medium. Retrieved on 3 Jan. 2023, from https://medium.com/coinmonks/introduction-to-the-metaverse-454e3532309f.

Flew, T. & Martin, F.R. (2022). Digital Platform Regulation: Global Perspectives on Internet Governance. Palgrave Macmillan.

Forbes. (2023). The Best Robo-Advisors of 2022. Forbes Advisor. Retrieved on 7 Apr., 2023, from https://www.forbes.com/advisor/investing/best-robo-advisors/.

Forbes. (n.d.). The World's Most Powerful Brands. Retrieved on 17 Apr. 2023, from https://www.forbes.com/powerful-brands/list/.

Forkast. (2021). Research Report - State of the NFT Market Q1 2021.

Forrester (2017). Tech Radar: Artificial Intelligence Technologies Q1, 2017, It's Time To Put On Your Training Wheels. Forrester.

Foss, N. J. (1996). Research in Strategy, Economics, and Michael Porter. Journal of Management Studies, 33(1), 1-24.

Foss, N. J. (1997). Resources and Strategy: A brief Overview of Themes and Contributions. In N. J. Foss (Ed.), Resources, Firms and Strategies: A Reader in the Resource-Based Perspective (3-18). New York: Oxford University Press.

Francis, D. L. & Bessant, J. (2005). Targeting Innovation and Implications for Capability Development. Technovation, 25(3).

French Ministry for Europe and Foreign Affairs. (2018). Paris Call - For trust and security in cyberspace. Retrieved on 9 Feb. 2019, from https://pariscall.international/en/.

Frier, S. (2022). The Inside Story of How Facebook Acquired Instagram. Medium. Retrieved on 23 Jan. 2023, from https://onezero.medium.com/the-inside-story-of-how-facebook-acquired-instagram-318f244f1283.

Future of Humanity Institute. (2018). The Malicious Use of Artificial Intelligence: Forecasting, Prevention, and Mitigation. Retrieved on 16. Feb. 2019, from https://arxiv.org/pdf/1802.07228.pdf.

Galloway, S. (2017). The Four: The Hidden DNA of Amazon, Apple, Facebook, and Google. Bantam Press.

Gangane, S., & Kakade, V. (2015). Base of the Networking Protocol – TCP/IP Its Design and Security Aspects. International Journal of Innovative Research in Computer and Communication Engineering, 3(4), 3194-3201.

Garcia, R., & Calantone, R. J. (2002). A critical look at technological innovation typology and innovativeness terminology: A literature review. Journal of Product Innovation Management, 19(2).

Gatignon, H., Tushman, M. L., Smith, W. K., & Anderson, P. (2002). A Structural Approach to Assessing Innovation: Construct Development of Innovation Locus, Type, and Characteristics. Journal of Management, 48(9), 1360-1384.

Gawer, A. (2012). Platforms, Markets, and Innovation. Cheltenham: Edward Elgar Publishing.

Gawer, A. (2014). Bridging differing perspectives on technological platforms: Toward an integrative framework. Research Policy, 43(7), 1164-1179. Retrieved on 2 Apr. 2019, from https://www.sciencedirect.com/science/article/pii/S0048733314000456.

Gawer, A., & Cusumano, M. A. (2008). How companies become platform leaders. MIT Sloan Management Review. Retrieved on 13 Nov. 2020, from http://sloanreview.mit.edu/article/how-companies-become-platform-leaders/.

Gawer, A., & Cusumano, M. A. (2014). Industry Platforms and Ecosystem Innovation. Journal of Product Innovation Management, 31(3), 408-421.

GDPR.eu. (n.d.). What is GDPR? Retrieved on 8 Apr. 2023, from https://gdpr.eu/what-is-gdpr/.

Gepner, P. & Kowalik, M. (2006) Multi-Core Processors: New Way to Achieve High System Performance. PARELEC 2006 - Proceedings: International Symposium on Parallel Computing in Electrical Engineering, 9-13.

Ghemawat, P. (1986). Sustainable Advantage. Harvard Business Review, 64(5), 53-58.

Ghemawat, P. (1991). Commitment: The Dynamic of Strategy. New York: Free Press.

Gibson, Dunn & Crutcher LLP. (2021). U.S. Copyright Office Releases Report on Recommended Changes to Digital Millennium Copyright Act (DMCA). Retrieved on 28 May, 2021, from https://www.gibsondunn.com/u-s-copyright-office-releases-report-on-recommended-changes-to-digital-millennium-copyright-act-dmca/.

Gillespie, T. (2020). Content moderation, AI, and the question of scale. Big Data & Society, 7.

Gillespie, T., Boczkowska, P. J. & Foot, K. A. (2014). Media Technologies: Essays on Communication, Materiality, and Society. MIT Press Scholarship.

Gold, A. & Hogendorn, C. (2015). Tipping in Two-Sided Markets with Asymmetric Platforms. Wesleyan Working Papers.

Goldratt, E. M. & Cox, J. (2014). The Goal: A Process of Ongoing Improvement. North River Press (30th Anniversary Edition).

Golnam, A., Ritala, P., & Wegmann, A. (2014). Coopetition within and between value networks - a typology and a modelling framework. International Journal of Business Environment, 6, 47-68.

Goode, A. (2021). Meta-Analysis - advertising and the metaverse. WARC.

Google Ads. (n.d.). About Dynamic Search Ads. Google Ads Help. Retrieved on 3 Mar. 2023, from https://support.google.com/google-ads/answer/2472725?hl=en.

Google Cloud. (n.d.a). Tensor Processing Units (TPUs). Retrieved on 22 Apr. 2022, from https://cloud.google.com/tpu/docs/tpus?hl=de.

Google Cloud. (n.d.b). What is artificial intelligence (AI)? Google Cloud. Retrieved on 9 Apr. 2023, from https://cloud.google.com/learn/what-is-artificial-intelligence?hl=de.

Google Cloud. (n.d.c). Artificial Intelligence Solutions. Retrieved on 2 Feb 2022, from https://cloud.google.com/products/ai?hl=de.

Google Developers. (n.d.). The architecture of generative adversarial networks. Google Developers. Retrieved on 2 Apr. 2023, from https://developers.google.com/machine-learning/gan/gan_structure?hl=de.

Google Fiber. (2020). Google Fiber Webpass Cities. Retrieved on 14 May 2022, from https://webpass.net/about_us.

Gopalakrishnan, S., Damanpour, F. and Fariborz, S. (1997). A review of innovation research in economics, sociology and technology management, Omega, vol. 25, no. 1, Elsevier.

Govindarajan, V., Kopalle, P. & Praveen K., D. (2006). Disruptiveness of Innovations: Measurement and an Assessment of Reliability and Validity, Strategic Management Journal, vol. 27, no.2.

Grad, B. (2022). History of Computing Industry Infrastructure. IEEE Annals of the History of Computing, 44(1), 131-132.

Grand View Research. (2021). Augmented Reality Market Size, Share & Trends Analysis Report by Component, By Display (HMD & Smart Glass, HUD, Handheld Devices), By Application, By Region, And Segment Forecasts, 2021 - 2028. Grand View Research.

Grandison, T. & Bhatti, R. (2010). HIPAA compliance and patient privacy protection. Studies in health technology and informatics, 160, 884-888.

Grant, R. M. (1991). The Resource-Based Theory of Competitive Advantage: Implications for Strategy Formulation. California Management Review, 114-135.

Grayscale Research. (2021). The Metaverse - Web 3.0 Virtual Cloud Economies.

Green, J. (2023). Netflix's complicated role as an innovative disruptor in the film industry. ESIC Digital Economy and Innovation Journal, 2.

Grinin, L. E., Devezas, T. C., & Korotayev, A. V. (2012). Kondratieff Waves: Dimensions and Prospects at the Dawn of the 21st Century. Volgograd: Uchitel Publishing House.

Guardtime. (2016). Estonian eHealth partners with Guardtime for blockchain-based transparency. Retrieved on 19 Apr. 2020, from https://guardtime.com/blog/estonian-ehealth-partners-guardtime-blockchain-based-transparency.

Gunther, R., Beck, P. A., & Nisbet, E. C. (2018). Fake News May Have Contributed to Trump's 2016 Victory. Ohio State University. Retrieved on 11 May 2019, from https://www.documentcloud.org/documents/4429952-Fake-News-May-Have-Contributed-to-Trump-s-2016

Gussek, L. & Wiesche, M. (2021). The Gig Economy: Workers, Work and Platform Perspective.

Habermas, J. (1971). Technology and Science as Ideology. In J. Habermas & J. Shapiro (Eds.), Toward a Rational Society: Student Protest, Science, and Politics. Boston: Beacon Press.

Habermas, J. (1974). Theory and Practice. Translated by John Viertel. Beacon Press.

Hackl, C. (2021). Defining the Metaverse Today. Forbes. Retrieved on 21 Mar 2022, from https://www.forbes.com/sites/cathyhackl/2021/05/02/defining-the-metaverse-today/?sh=4bee1bb16448.

Hall, R. (1992). The strategic analysis of intangible resources. Strategic Management Journal, 13(2), 135-144.

Hamari, J., Malik, A., Koski, J., & Johri, A. (2018). Uses and gratifications of Pokémon Go: Why do people play mobile location-based augmented reality games? International Journal of Human-Computer Interaction, 35(9), 804-819.

Hamari, J., Sjöklint, M., & Ukkonen, A. (2016). The Sharing Economy: Why People Participate in Collaborative Consumption. Journal of the Association for Information Science and Technology, 67(9), 2047-2059.

Hang, C., Chen, J., & Subramian, A. M. (2015). Developing Disruptive Products for Emerging Economies: Lessons from Asian Cases. Research Technology, 54(3).

Haraway, D. (1991). A cyborg manifesto: Science, technology, and socialist feminism in the late twentieth century. In Simians, cyborgs and women: The reinvention of nature (149-181). New York: Routledge.

Hart, S. L., & Christensen, C. M. (2002). The Great Leap: Driving Innovation from the Base of the Pyramid. MIT Sloan Management Review, 44(1).

Harvard Business Review. (2013). The Rise of the Mobile-Only US. Retrieved on 5 Dec. 2022, from https://hbr.org/2013/05/the-rise-of-the-mobile-only-us.

Harvard Business School Online. (2021). Data Collection Methods: From Surveys to Sensors. Retrieved on 5 Dec. 2022, from https://online.hbs.edu/blog/post/data-collection-methods.

Hatzikian, Y. (2015). Exploring the link between innovation and firm performance. Journal of the Knowledge Economy, 6(4).

Haul, M.G. (2014). Electronic Communications Privacy Act: Overview and Issues for Consideration, Congressional Research Service Reports.

Hawkins, M. (2020). The History and Rise of APIs. Forbes. Retrieved 7 Aug. 2022, from https://www.forbes.com/sites/forbestechcouncil/2020/06/23/the-history-and-rise-of-apis/.

Hazlett, T., Teece, D., & Waverman, L. (2011). Walled Garden Rivalry: The Creation of Mobile Network Ecosystems. SSRN Electronic Journal.

Heidegger, M. (1977). The Question Concerning Technology and Other Essays. Translated and with an Introduction by W. Lovitt. Garland Publishing, Inc.

Heise Online. (2014). 20 Jahre Smartphone: Mit IBM's Simon fing alles an. Retrieved 12 Feb. 2023, from https://www.heise.de/news/20-Jahre-Smartphone-Mit-IBMs-Simon-fing-alles-an-2293693.html.

Henderson, F. (2019). Software engineering at Google. Computer Science, ArXiv.

Henderson, R. (2005). The innovator's dilemma as a problem of organizational competence. Journal of Product Innovation Management, 23(1).

Henderson, R., Clark, K., & Kim, Y. (1990). Architectural innovation: The reconfiguration of existing product technologies and the failure of established firms. Administrative Science Quarterly, 35(1).

Herrman, J., & Browning, K. (2021). Are We in the Metaverse Yet? The New York Times. Retrieved on 5 Apr. 2022, from https://www.nytimes.com/2021/07/10/style/metaverse-virtual-worlds.html.

Hijrah Hati, S., Balqiah, E., Hananto, A., & Yuliati, E. (2021). A decade of systematic literature review on Airbnb: the sharing economy from a multiple stakeholder perspective. Heliyon, 7.

Hodapp, D., & Hanelt, A. (2022). Interoperability in the era of digital innovation: An information systems research agenda. Journal of Information Technology, 37.

Hogarth, R.M., Michaud, C., Doz, Y., & van der Heyden, U. (1991). Longevity of Business Firms: A Four-Stage Framework for Analysis. Fontainebleau: INSEAD.

Holt, J., Sims, D., Fineman, S., & Gabriel, Y. (1995). Organizing and Organizations: An Introduction. The Journal of the Operational Research Society, 46, 136.

Honneth, A. (1991). Critique of Power: Reflective Stages in a Critical Social Theory. (K. Baynes, Trans.) Cambridge, Mass.: MIT Press. (Original work published 1985).

Hoque, F. (2007). Sustained Innovation. BT Press.

Horkheimer, M. (1976). Traditional and Critical Theory. In P. Connerton (Ed.), Critical Sociology: Selected Readings (188-243). Penguin. (Original work published 1937).

Houngbonon, G. V., Rossotto, C. M., & Strusani, D. (2021). Municipal Broadband Networks—Opportunities, Business Models, Challenges, and Case Studies. EM Compass Emerging Markets, Note 107.

Huang, J., He, D., Obaidat, M., Vijayakumar, P., Luo, M., & Choo, K.-K. R. (2021). The Application of the Blockchain Technology in Voting Systems: A Review. ACM Computing Surveys, 54, 1-28.

Iansiti, M., & Levien, R. (2004). The Keystone Advantage: What the New Dynamics of Business Ecosystems Mean for Strategy, Innovation and Sustainability. Harvard Business Review Press.

Iberdrola. (n.d.). Virtual Reality. Retrieved on 12 Apr. 2023, from https://www.iberdrola.com/innovation/virtual-reality.

IBM Food Trust. (2020). An IBM Blockchain solution for the complete food system Working to make the food ecosystem safer, smarter, and more sustainable: IBM Food Trust Solution Brief 2.0.

IBM. (2021). IBM Launches New Watson Capabilities to Help Businesses Build Trustworthy AI. Retrieved on 8 Apr. 2023, from https://newsroom.ibm.com/2021-04-21-IBM-Launches-New-Watson-Capabilities-to-Help-Businesses-Build-Trustworthy-AI.

IBM. (n.d.a). API. Retrieved on 27 Mar. 2022, from https://www.ibm.com/topics/api.

IBM. (n.d.b). What is Supervised Learning? IBM. Retrieved on 6 Apr. 2021, from https://www.ibm.com/topics/supervised-learning.

IBM. (n.d.c). Natural Language Processing. IBM. Retrieved on 1 Apr. 2023, from https://www.ibm.com/topics/natural-language-processing.

Iddenden, G. (2021). The Metaverse - A Paradigm Shift for Brands. Charged Retail. Retrieved on 22 Nov. 2021, from https://www.chargedretail.co.uk/2021/11/19/the-metaverse-a-paradigm-shift-for-brands/.

IEEE Wireless Standards. (n.d.). OmniSecu. Retrieved on 25 Feb. 2023, from https://www.omnisecu.com/basic-networking/ieee-802-11-standards.php.

IFPI. (2020). Report: There were 400m music subscribers globally at end of Q1 2020. Retrieved on 29 Apr. 2021, from https://musically.com/2020/06/23/report-there-were-400m-music-subscribers-globally-at-end-of-q1-2020/.

Ikoba, J.J. (2020). Google Chrome tops both the mobile & desktop browser market share- Report. Gizmochina. Retrieved on 26 Jun. 2021, from https://www.gizmochina.com/2020/02/06/google-chrome-tops-both-the-mobile-desktop-browser-market-share-report/.

Imola, F. (2019). Do Artifacts Have Politics? by Langdon Winner: A Reflection. Medium. Retrieved on 25 Aug. 2021, from https://francescoimola.medium.com/do-artifacts-have-politics-by-langdon-winner-a-reflection-bde891f9f546.

Inglobe Technologies. (n.d.). Metaverse Platforms: What they are and how to create one. Retrieved on 3 Jan. 2023, from https://www.inglobetechnologies.com/metaverse-platforms/.

Inscribe. (n.d.). AI Fraud Detection: Protect Your Business from Fraud. Inscribe. Retrieved on 6 Apr., 2023, from https://www.inscribe.ai/fraud-detection/ai-fraud-detection.

International Federation of the Phonographic Industry (2019). Global music report 2019.

International Federation of the Phonographic Industry (2023). Global music report 2023.

Investopedia. (2020). Facebook Is the Biggest Threat to Google's Ad Revenue Throne. Investopedia Tech Stocks. Retrieved on 29 Jan. 2021, from https://www.investopedia.com/articles/investing/060315/why-facebook-biggest-threat-googles-adrevenue-throne.asp.

Investopedia. (2021). Acquisitions and Antitrust Scrutiny for Big Tech Firms. Retrieved on 11 Oct. 2021, from https://www.investopedia.com/acquisitions-and-antitrust-scrutiny-for-big-tech-firms-5204875.

Investopedia. (2022). Augmented Reality (AR). Retrieved on 1 Apr. 2023, from https://www.investopedia.com/terms/a/augmented-reality.asp.

Investopedia. (2022). Blockchain. Retrieved on 7 Dec. 2023, from https://www.investopedia.com/terms/b/blockchain.asp.

Investopedia. (2023). Data Mining. Investopedia. Retrieved on 15 Jun. 2022, from https://www.investopedia.com/terms/d/datamining.asp.

Iot For All. (2023). The Impact of Artificial Intelligence on Job Losses. Retrieved on 8 Apr. 2023, from https://www.iotforall.com/impact-of-artificial-intelligence-job-losses.

IPFS. (2020). List of Google domains. IPFS. Retrieved on 7 Nov. 2020, from https://ipfs.io/ipfs/QmXoypizjW3WknFiJnKLwHCnL72vedxjQkDDP1mXWo6uco/wiki/List_of_Google_domains.html.

Iqbal, M. (2020a). Uber Revenue and Usage Statistics. Business of Apps. Retrieved on 7 Nov. 2020, from https://www.businessofapps.com/data/uber-statistics/.

Iqbal, M. (2020b). WeChat Revenue and Usage Statistics. Business of Apps. Retrieved on 7 Nov. 2020, from https://www.businessofapps.com/data/wechat-statistics/.

Iqbal, M. (2020c). TikTok Revenue and Usage Statistics. Business of Apps. Retrieved on 7 Nov. 2020, from https://www.businessofapps.com/data/tik-tok-statistics/.

Isckia, T., de Reuver, M., & Lescop, D. (2020). Orchestrating Platform Ecosystems: The Interplay of Innovation and Business Development Subsystems. Journal of Innovation Economics & Management, 2020(2), 197-223.

Issues in Science and Technology. (2017). The Rise of the Platform Economy and Big Data: Is This the End of Work as We Know It? Retrieved on 3 Jan. 2023, from https://issues.org/rise-platform-economy-big-data-work/.

Itami H. & Roehl, T.W. (1987). Mobilizing Invisible Assets, Cambridge, Massachusetts: Harvard University Press.

Iterators. (2022). Metaverse: A Comprehensive Guide to a New Digital Dimension, Iterators HQ.

Jadhav, J. S., & Deshmukh, J. (2022). A review study of the blockchain-based healthcare supply chain. Social Sciences & Humanities Open, 6(1), 100328.

Jaekel, M. (2020). Disruption durch digitale Plattform-Ökosysteme: Eine kompakte Einführung, Springer Vieweg.

Janadari, N. & Preena, G.R. (2020). The Gig Economy and Workforce, in Contemporary Developments in Human Resource Management, Department of Human Resource Management, University of Kelaniya, 1-14.

Janakiraman, M. S. V. (2020). A Look Back At Ten Years Of Microsoft Azure. Forbes. Retrieved on 4 Apr. 2023, from https://www.forbes.com/sites/janakirammsv/2020/02/03/a-look-back-at-ten-years-of-microsoft-azure/.

Jasanoff, S. (2002). New Modernities: Reimagining Science, Technology and Development. Environmental Values, 11(3), 253-276.

Jeweler, M. (2008). The Communications Decency Act of 1996: Why § 230 is Outdated and Publisher Liability for Defamation Should be Reinstated Against Internet Service Providers. Pittsburgh Journal of Technology Law and Policy, 8.

Jiang, M. (2012). Internet Companies in China: Dancing Between the Party Line and the Bottom Line. Asie Visions, 47.

Jiang, S., Robertson, R. E., & Wilson, C. (2020). Reasoning about Political Bias in Content Moderation. Proceedings of the AAAI Conference on Artificial Intelligence, 34.

Jin, Y., Vonderembse, M., & Ragu-Nathan, T. (2013). Proprietary technologies: Building a manufacturer's flexibility and competitive advantage. International Journal of Production Research, 51.

Johnson, N.L. (2017). What are Network Effects? Retrieved on 14 May. 2021, from https://www.applicoinc.com/blog/network-effects/.

Jones Day. (2022). Global Merger Control Update - Fall 2022. Retrieved on 1 Nov. 2022, from https://www.jonesday.com/en/insights/2022/10/global-merger-control-update--fall-2022.

Kalender, Z., Günay, N., & Vayvay, Ö. (2014). Theory of Constraints: A Literature Review. Procedia - Social and Behavioral Sciences, 150, 930-936.

Kantar. (2021). 2022 Media Trends and Predictions Report.

Karagiannopoulos, G., Georgopoulos, N.; & Nikolopoulos, K. (2005). Fathoming Porter's five forces model in the Internet era, Emerald Group Publishing Limited, v.7, n.6.

Kaye, D. (2020). Report of the Special Rapporteur on the promotion and protection of the right to freedom of opinion and expression, United Nations Human Rights, Office of the High Commissioner, Human Rights Council, 38. Session, Retrieved on 14 May 2020, from https://www.ohchr.org/en/issues/freedomopinion/pages/opinionindex.aspx.

Keese, C. (2016). Silicon Valley: Was aus dem mächtigsten Tal der Welt auf uns zukommt (Silicon Valley: What Comes to Us from the World's Most Powerful Valley). Murmann Verlag.

Kelly, D. (2021). A Virtual Gucci Bag Sold for More Money on Roblox Than the Actual Bag. Hypebeast. Retreived on 6 Feb. 2021, from https://hypebeast.com/2021/5/virtual-gucci-bag-roblox-resale.

Kelly, M. & Satola, D. (2017). The right to be forgotten. University of Illinois Law Review, 2017, 1-64.

Kemp, S. (2020). Digital 2020: 3.8 billion people use social media. We Are Social. Retrieved on 14 Jan 2021, from https://wearesocial.com/uk/blog/2020/01/digital-2020-3-8-billion-people-use-social-media/.

Kerber, W. & Schweitzer, H. (2017). Interoperability in the Digital Economy. Journal of Intellectual Property, Information Technology and Electronic Commerce Law, MAGKS Joint Discussion Paper Series in Economics.

Kerns, T. (2019). There are now more than 2.5 billion active Android devices. Android Policy. Retrieved on 19 Jun. 2019, from https://www.androidpolice.com/2019/05/07/there-are-now-more-than-2-5-billion-active-android-devices/.

Khan, I., & Alam, M. (2017). Cloud computing: Issues and future direction. Global SciTech, 9, 37.

Kim, J. W., & Ha, S. (2014). Price Comparisons on the Internet Based on Computational Intelligence. PloS one, 9, e106946.

King, A. A. & Baatartogtokh, B. (2015). How Useful Is the Theory of Disruptive Innovation? MIT Sloan Management Review, 57(1).

Kleinschmidt, E. J. & Cooper, R. (1991). The Impact of Product Innovativeness on Performance. Journal of Product Innovation Management, 8(4).

Klomp, L. & Van Leeuwen, G. (2010). Linking Innovation and Firm Performance: A New Approach. International Journal of the Economics of Business, 8(3).

Kolossovski, E. (2019). A Strategist's Guide to Platform Thinking. Medium. Retrieved on 21 May. 2020, from https://medium.com/@eleanor.kolossovski/a-strategists-guide-to-platform-thinking-9069b60e5f5a.

Kong. (n.d.). What is the API Economy? Kong Blog. Retrieved on 7 Apr. 2023, from https://konghq.com/blog/enterprise/api-economy/.

Kooti, F., Grbovic, M., Aiello, L., Djuric, N., Radosavljevic, V., & Lerman, K. (2017). Analyzing Uber's Ride-sharing Economy. In Proceedings of the 26th International Conference on World Wide Web (574-582).

Kordzadeh, N., & Ghasemaghaei, M. (2021). Algorithmic bias: review, synthesis, and future research directions. European Journal of Information Systems, 31, 1-22.

Krugman, P. R. (1986). Strategic trade policy and the new international economics. MIT Press, Cambridge, Massachusetts.

Kumar, R. (2019). Major Acquisitions by Facebook: Integrated Case Studies. In Ratten, V., Braga, V., Marques, C. S., & da Silva, F. (Eds.), Entrepreneurial Innovation and Economic Development in Dubai and Comparisons with its Sister Cities (321-327). Springer.

Kurzweil, R. (1999). The Age of Spiritual Machines: When Computers Exceed Human Intelligence. Penguin Books.

Kwazo, H., Muhammad, M. U., Tafida, G. M., & Mohammed, S. (2014). Environmental Impact of Technologies. Academic Journal of Interdisciplinary Studies, 3(7), 83-88.

Lara, M., Saucedo, J., Marmolejo, J., Salais, T., & Vasant, P. (2020). Vertical and horizontal integration systems in Industry 4.0. Wireless Networks, 26.

Latour, B. (1988). Science in Action: How to Follow Scientists and Engineers Through Society. Harvard University Press.

Laubscher, H. (2018). For Brands, Alibaba Is The Gateway To China And Chinese Customers. Forbes. Retrieved on 11 Jul. 2020, from https://www.forbes.com/sites/hendriklaubscher/2018/06/28/brands-alibaba-is-the-gateway-to-china-chinese-customers/#7aa7d48e1658.

Launay, Y., & Mas, N. (2008). Virtual Worlds Research: Consumer Behavior in Virtual Worlds. Journal of Virtual Worlds Research, 1(2).

Lawson, T. (2013). What is this 'school' called neoclassical economics? Cambridge Journal of Economics, 37(5), 947-983.

Lawson, T. (2021). Whatever happened to neoclassical economics? Revue de Philosophie Économique 22(1).

Lechmanová, K., Kocichová, N., & Vedeikytė, I. (2020). How one company disrupted the whole industry.

Lee, D. (2019). Apple says there are 1.4 billion active Apple devices. The Verge. Retrieved on 11 Jul. 2020, from https://www.theverge.com/2019/1/29/18202736/apple-devices-ios-earnings-q1-2019.

Leonard-Barton, D. (1992). Core Capabilities and Core Rigidities: A Paradox in Managing New Product Development. Strategic Management Journal, 13(Special Issue), 111-125.

Levin, A. (2020). Creator-Centric Strategies: Extend your value beyond pay and increase your ROI with a creator-centric perspective to influencer marketing. In The Social Media Handbook: Rules, Policies, and Best Practices (79-94). Springer.

Li, T., & Calantone, R. J. (1998). The Impact of Market Knowledge Competence on New Product Advantage: Conceptualization and Empirical Examination. Journal of Marketing, 62(4), n.p.

Lieberman, M. B., & Montgomery, D. B. (1988). First-mover advantages. Strategic Management Journal, 9(S1), 41-58.

LightReading. (2021). Google Fiber revs up network expansion efforts. Light Reading. Retrieved on 30 Jan 2023, from https://www.lightreading.com/opticalip-networks/google-fiber-revs-up-network-expansion-efforts/d/d-id/779617.

Linden, G. (2016). Economies of Scale. In G. Kurian (Ed.). The Encyclopedia of Political Science (1-3). Palgrave Macmillan UK.

Linton, J. (2009). De-babelizing the Language of Innovation. Technovation, 29(11), 2009.

Lipscombe, D. (2022). Roblox is Dead, Long Live Roblox. GMW3. Retrieved on 4 Jun. 2022, from https://www.gmw3.com/2022/04/roblox-is-dead-long-live-roblox/.

Lister, M., Dovey, J., Giddings, S., Grant, I., & Kelly, K. (2008). New Media: A Critical Introduction (2nd Ed.). Routledge.

Loukides, M. (2002). Learning the UNIX Operating System. O'Reilly Media, Inc.

Luby, L. (2021). Roblox Might Have A Large Impact On Apple Vs. Epic. WhatIfGaming. Retrieved on 4 Jun. 2022, from https://whatifgaming.com/roblox-might-have-a-large-impact-on-apple-vs-epic/.

Lundqvist, B. (2022). An access and transfer right to data-from a competition law perspective, Journal of Antitrust Enforcement, jnac017.

Lybeck, J. (2011). A Global History of the Financial Crash of 2007-10. Cambridge: Cambridge University Press.

Lynn, T., Rosati, P., Conway, E., Curran, D., Fox, G., & O'Gorman, C. (2022). The Digital Economy and Digital Business. In Digital Business and Sustainable Development (69-89). Springer.

MacRumors. (2020). Apple Stores - Keep track of Apple's retail stores worldwide. MacRumors. Retrieved on 11 Jul. 2020, from https://www.macrumors.com/roundup/apple-retail-stores/.

Madiega, T., Car, P., Niestadt, M., & Van de Pol, L. (2022). The European Union and Artificial Intelligence: Overview of the EU Policy Landscape. EPRS. European Parliamentary Research Service.

Majeed, H. (2017). How Facebook Algorithms Show Posts on Users Pages: Survey Study. International Journal of Computer Science and Mobile Computing, 6, 153-159.

MakeUseOf. (2022). Companies investing in the Metaverse. Retrieved on 6 Apr. 2023, from https://www.makeuseof.com/companies-investing-in-metaverse/.

Malos, S., Lester, G., & Virick, M. (2018). Uber Drivers and Employment Status in the Gig Economy: Should Corporate Social Responsibility Tip the Scales? Employee Responsibilities and Rights Journal, 30.

Mandel, E. (1976). Late Capitalism. NLB, UK: London.

Mandel, E. (1995). Long Waves of Capitalist Development - A Marxist Interpretation. London and New York: Verso.

Manifesto. (n.d.). The history of mobile application development. Retrieved on 2 Apr. 2023, from https://manifesto.co.uk/history-mobile-application-development/.

Marcuse, H. (1991). One-Dimensional Man: Studies in the Ideology of Advanced Industrial Society (2nd Ed.). Beacon Press.

MarketsandMarkets (2023). Global Big Data Market size to reach USD 274 billion by 2023. MarketsandMarkets.

Markides, C. (2006). Disruptive Innovation: In Need of Better Theory. The Journal of Product Innovation Management, 23, 2006.

Marr, B. (2018). Blockchain: A Very Short History Of Ethereum Everyone Should Read. Retrieved on 8 Jun. 2019, from https://bernardmarr.com/blockchain-a-very-short-history-of-ethereum-everyone-should-read/.

Marr, B. (2023). The Real Reasons for Big Tech Layoffs at Google, Microsoft, Meta and Amazon. Forbes. Retrieved on 2 Apr. 2023, https://www.forbes.com/sites/bernardmarr/2023/01/30/the-real-reasons-for-big-tech-layoffs-at-google-microsoft-meta-and-amazon/.

Marret, C. (2020). The relative impact of the Facebook's algorithm on the creation of social bubbles.

Marzouk, N. (2018). Retail, Finance, Healthcare – Every Industry Needs Its Own Data Stack. Advertising Week. Retrieved on 21 Apr. 2022, from https://advertising-week.com/retail-finance-healthcare-every-industry-needs-its-own-data-stack/.

Massey, P. (2000). Market definition and market power in competition analysis: Some practical issues. The Economic and Social Review, 31, 309-328.

Mayer-Schönberger, V. (2017). Ich nehme bewusst in Kauf, früher zu sterben, Die Zeit, n.42, Hamburg.

McAuliffe, R. E. (2015a). Herfindahl-Hirschman Index. In The Wiley Encyclopedia of Management (1-2). Wiley.

McAuliffe, R. E. (2015b). Producer Surplus. In The Encyclopedia of Operations Management: A Field Manual and Glossary of Operations Management Terms and Concepts (1-3). John Wiley & Sons, Inc.

McChesney, R. W., & Nichols, J. (2016). People Get Ready: The Fight Against a Jobless Economy and a Citizenless Democracy. New York: Nation Books.

McGee, J. (2014a). Economies of Scope. In M. A. Pagano (Ed.), The Encyclopedia of Management Theory (2). Wiley.

McGee, J. (2014b). Value Creation and Value Analysis. In The Wiley Encyclopedia of Management (1-4). Wiley.

McGee, J., & Sammut-Bonnici, T. (2014). Competitive Strategy. In Wiley Encyclopedia of Management (4-4). John Wiley & Sons.

McKinsey&Company. (2021). What is the Metaverse? McKinsey Explainers. Retrieved on 3 Jan. 2023, from https://www.mckinsey.com/featured-insights/mckinsey-explainers/what-is-the-metaverse.

McKinsey&Company. (2022). Enduring Ideas: The SCP Framework. Available at: Retrieved on 4 Jun. 2022, from https://www.mckinsey.com/capabilities/strategy-and-corporate-finance/our-insights/enduring-ideas-the-scp-framework.

McKinsey Global Institute (2017a) Artificial Intelligence: The next digital frontier? McKinsey Global Institute, Discussion paper.

McKinsey Global Institute. (2017b). Jobs lost, jobs gained: What the future of work will mean for jobs, skills, and wages. Retrieved on 27 Mar 2020, from https://www.mckinsey.com/featured-insights/future-of-work/jobs-lost-jobs-gained-what-the-future-of-work-will-mean-for-jobs-skills-and-wages.

McLuhan, M. (1994). Understanding media: The extensions of man. MIT press.

MDN Web Docs. (n.d.).XML introduction. Mozilla Developer Network, Retrieved on 12 Feb. 2023, https://developer.mozilla.org/en-US/docs/Web/XML/XML_introduction.

Meta (2023). Company Info. Retrieved on 19 Sep. 2020 from https://about.fb.com/company-info/.

Meta. (2021). Facebook Company Is Now Meta. Retrieved on 3 Nov. 2021, from https://about.fb.com/news/2021/10/facebook-company-is-now-meta/.

Metzger, A., Senftleben, M., Derclaye, E., Dreier, T., Geiger, C., Griffiths, J., ... Xalabarder, R. (2020). Selected Aspects of Implementing Article 17 of the Directive on Copyright in the Digital Single Market into National Law - Comment of the European Copyright Society. SSRN Electronic Journal.

Miciuła, I., & Kazojć, K. (2019). The global development of cryptocurrencies. Prace Naukowe Uniwersytetu Ekonomicznego we Wrocławiu, 63, 183-196.

Microsoft. (n.d.). What is SaaS? Retrieved on 28 Feb. 2023, from https://azure.microsoft.com/en-us/resources/cloud-computing-dictionary/what-is-saas.

Miller, D. (1992). The Generic Strategy Trap. Journal of Business Strategy, 13(1), 37-41.

Miltsov, A. (2022). Researching TikTok: Themes, methods, and future directions. In A. Quan-Haase & L. Sloan (Eds.), The SAGE Handbook of Social Media Research Methods (2nd ed., 664-676). SAGE.

Mintzberg, H. (1994). The Fall and Rise of Strategic Planning. Harvard Business Review, 72(1).

Mintzberg, H., Ahlstrand, B., & Lampel, J. (1998). Strategy Safari: A Guided Tour Through the Wilds of Strategic Management. New York: The Free Press.

Mokronosov, A., & Anisimova, M. (2020). Digital Platform Antitrust Approaches. In 2nd International Scientific and Practical Conference Modern Management Trends and the Digital Economy: from Regional Development to Global Economic Growth (MTDE 2020).

Moore, G. (2004). Darwin and the Demon: Innovating Within Established Enterprises. Harvard Business Review, 82(7-8).

Mosco, V. (2008). The political economy of communication. Sage.

Mozilla. (n.d.). HTTP - Overview. Mozilla Developer Network. Retrieved on 6 Aug. 2022, from https://developer.mozilla.org/en-US/docs/Web/HTTP/Overview.

MQTT. (n.d.). MQTT. Retrieved on 4 May 2022, from https://mqtt.org/.

Mulgund, P., Mulgund, B., Sharman, R., & Singh, R. (2021). The Implications of the California Consumer Privacy Act (CCPA) on Healthcare Organizations: Lessons Learned From Early Compliance Experiences. Health Policy and Technology, 10.

Murugesan, S. (2007). Understanding Web 2.0. IT Professional, 9(4), 34-41.

Nair, A. (2021). Verily: The project to revolutionize healthcare. Medium. Retrieved on 3 Mar. 2023, from https://ayannair2021.medium.com/verily-the-project-to-revolutionize-healthcare-42852401bde1.

Narula, U. (2006). Dynamics of Mass Communication: Theory and Practice. Atlantic Publishers & Distributors Ltd.

National Institute of Standards and Technology (NIST). (n.d.). Protocol. Retrieved on 4 Mar. 2022, from https://www.techtarget.com/searchnetworking/definition/TCP.

National Research Group. (2021). For Meta or for Worse - The Promise and Perils of the Metaverse. National Research Group.

NBA. (2022). NBA announces partnership with Fortnite, unveils outfits for all 30 teams. Retrieved on 2 Mar. 2022, from https://www.nba.com/news/nba-announces-partnership-with-fortnite-unveils-outfits-for-all-30-teams.

Nelson, R. R. (1991). Why do firms differ, and how does it matter? Strategic Management Journal, 12(2), 61-74.

Nelson, R. R., & Winter, S. (1977). In Search of a Useful Theory of Innovation. In R. R. Nelson & S. Winter (Eds.), Innovation, Economic Change and Technology Policies. Basel: Birkhäuser.

Nelson, R. R., & Winter, S. (1982). An Evolutionary Theory of Economic Change. Cambridge: Harvard University Press.

Net Marketshare. (2020). Operating System Market Share/Mobile. Retrieved on 14 May 2022, from https://www.netmarketshare.com/.

Newley, P. & Horwitz, J. (2020). Facebook Hate-Speech Rules Collide With Indian Politics. The Wall Street Journal. Retrieved on 24 May 2022, from https://www.wsj.com/articles/facebook-hate-speech-india-politics-muslim-hindu-modi-zuckerberg-11597423346.

Niels, G. (2019). Transaction versus non-transaction platforms: a false dichotomy in two-sided market definition. Journal of Competition Law & Economics, 15.

Niu, E. (2019). As Usual, Apple's App Store Revenue Leads Google Play in Third Quarter. The Motley Fool. . Retrieved on 30 Jul. 2020, https://www.fool.com/investing/2019/10/11/as-usual-apples-app-store-revenue-leads-google-pla.aspx.

Nobari, A. D., Reshadatmand, N., & Neshati, M. (2017). Analysis of Telegram, an instant messaging service. In Proceedings of the 8th International Conference on Information and Communication Technology for Sustainable Development (2035-2038).

Noble, D.F. (1986). Forces of Production: A Social History of Industrial Automation. New Brunswick: Transaction Publishers.

Noble, D.F. (1993). Progress Without People: New Technology, Unemployment, and the Message of Resistance. Toronto: Between the Lines Press.

Novac, O.C., Novac, M., Gordan, C., Berczes, T., & Bujdosó, G. (2017). Comparative study of Google Android, Apple iOS and Microsoft Windows Phone mobile operating

systems. 2017 14th International Conference on Engineering of Modern Electric Systems (EMES), 154-159.

Núñez-Tabales, J., Solano Sanchez, M. A., & Caridad López del Río, L. (2020). Ten years of Airbnb phenomenon research: A bibliometric approach (2010-2019). Sustainability, 12(15).

OAuth 2.0. (n.d.). Retrieved on 6 Apr. 2022, from https://oauth.net/2/.

OECD. (2000). Enhancing the competitiveness of SMEs in the global economy: Strategies and policies. Workshop 1 Enhancing the Competitiveness of SMEs through Innovation. Conference for Ministers responsible for SMEs and Industry Ministers Bologna, Italy, 14-15 June 2000.

OECD. (2005). Oslo Manual: Guidelines for Collecting and Interpreting Innovation Data. OECD and Statistical Office of the European Communities. 3rd Edition. Paris: OECD Publishing.

OECD. (2021). Data portability, interoperability and digital platform competition. OECD, Paris.

OECD. (2021). OECD Competition Trends 2021, Volume II, Global Merger Control.

OECD. (n.d.). International Co-operation and Competition. Retrieved on 22 Apr. 2023, from https://www.oecd.org/competition/internationalco-operationandcompetition.htm.

Oracle. (n.d.). What Is Big Data? Oracle. Retrieved on 17 Apr. 2023, from https://www.oracle.com/big-data/what-is-big-data/.

Orland, K. (2021). Putting Roblox's incredible $45 billion IPO in context. Ars Technica. Retrieved on 14 Jun. 2022, from https://arstechnica.com/gaming/2021/03/putting-robloxs-incredible-45-billion-ipo-in-context/.

Oskam, J., & Boswijk, A. (2015). Airbnb: The future of networked hospitality businesses. Journal of Tourism Futures, 2(1), 22-42.

Ostoj, I. (2021). The Logic of Gig Economy (Origins and Growth Prospects). Studies in Logic, Grammar and Rhetoric, 66, 451-462.

Ozturkcan, S. (2021). Service innovation: Using augmented reality in the IKEA Place app. Journal of Information Technology Teaching Cases, 11, 8-13.

Pacsun. (2021). Pacsun Forges Forward in Digital Space with Strong Momentum as They Unveil Integrated Experiences on Roblox. PCR Newswire. Retrieved on 4 Aug. 2022, from https://www.prnewswire.com/news-releases/pacsun-forges-forward-in-digital-space-with-strong-momentum-as-they-unveil-integrated-experiences-on-roblox-301306335.html.

Parker, G.G., Van Alstyne, M.W. & Choudary, S.P. (2016). Platform Revolution: How Networked Markets Are Transforming the Economy - and How to Make Them Work for You (Illustrated Ed.). W. W. Norton & Company.

Parker, G.G., Van Alstyne, M.W. & Choudary, S.P. (2017). How Networked Markets Are Transforming the Economy - and How to Make Them Work for You. W. W. Norton & Company.

Parkhe, A. (1993). Messy Research, Methodological Predispositions, and Theory Development in International Joint Ventures, Academy of Management Review, v.18, n.2., (227-268).

Parmenter, J. (2021). SXSW 2021: A Review of This Year's All-Digital Festival. Vinyl Chapters. Retrieved on 4 Aug. 2022, from https://www.vinylchapters.com/sxsw-2021-a-review-of-this-years-all-digital-festival/.

Pater, R. (2016). The Politics of Design. BIS Publishers.

Paul, S. (2018). Global internet market capitalisation leaders: where is the EU? Digital Policy, Regulation and Governance, 20(5), 600-608.

Penrose, E. T. (1959). The Theory of the Growth of the Firm. New York: John Wiley.

Peppard, J., & Rylander Eklund, A. (2006). From Value Chain to Value Network: Insights for Mobile Operators. European Management Journal, 24, 128-141.

Peteraf, M. A. (1993). The Cornerstones of Competitive Advantage: A Resource-Based View. Strategic Management Journal, 14(3), 179-191.

Petrov, C. (2020). 47 Amazon Statistics to Bedazzle You in 2020. TechJury. Retrieved on 22 Jun. 2021, from https://techjury.net/blog/amazon-statistics/#gref.

Pfarrer, M., & Smith, K. (2015). Creative Destruction. In The Wiley Encyclopedia of Management (1-3). Wiley.

Pickering, A. (2018). The Cybernetic Brain: Sketches of Another Future. University of Chicago Press.

Planful. (n.d.). CFOs and AI: It's Not Too Late to Get In the Game. Retrieved on 13 Apr. 2023, from https://planful.com/resources/white-papers/its-not-too-late-for-cfos-to-get-in-the-artificial-intelligence-game/.

Porter, J. (2021). Stranger Things' Starcourt Mall comes to Roblox. The Verge. Retrieved on 4 Aug. 2022, from https://www.theverge.com/2021/6/23/22546657/stranger-things-roblox-starcourt-mall-experience.

Porter, M. E. (1980). Competitive Strategy. New York: Free Press.

Porter, M. E. (1990). The Competitive Advantage of Nations. Harvard Business Review, 68(2).

Porter, M. E. (1991). Towards a Dynamic Theory of Strategy. Strategic Management Journal, 12, 95-117.

Porter, M. E. (1996). What is Strategy? Harvard Business Review, 74(6), 61-78.

Postman, N. (1993). Technopoly: The surrender of culture to technology. Vintage.

Prahalad, C. K., & Hamel, G. (1990). The Core Competence of the Corporation. Harvard Business Review, 68(3), 79-90.

Preneel, B. (2010). Cryptographic hash functions. European Transactions on Telecommunications, 5(4), 431-448.

PSFK. (2021). Partnership Between ARIA and Brookfield Properties Creates Geofenced AR Network. PSFK. Retrieved on 24 Mar. 2022, from, https://www.psfk.com/2021/11/partnership-between-aria-and-brookfield-properties-creates-geofenced-ar-network.html.

Radoff, J. (2021). Building the Metaverse. Beamable.

Raizada, A., Singh, K., & Sajid, M. (2020). Worldwide energy consumption of hyperscale data centers: A survey. International Research Journal on Advanced Science Hub, 2, 8-15.

Ramdorai, A., Herstatt, C. (2015). Frugal Innovation in Healthcare: How Targeting Low-Income Markets Leads to Disruptive Innovation. India Studies in Business and Economics. Springer.

Ratha, B. (n.d.). Web Browser: Netscape Navigator and Internet Explorer (Lecture notes). Devi Ahilya University.

Ravenscraft, E. (2022). What Is the Metaverse? Wired. Retrieved on 3 Jan. 2023, from https://www.wired.com/story/what-is-the-metaverse/.

Ray, P., Harsh, H. O., Daniel, A., & Ray, A. (2019). Incorporating Block Chain Technology in Food Supply Chain. International Journal of Management Studies, VI, 115.

Reed, Defillippi, R. & R J. (1990). Causal Ambiguity, Barriers to Imitation, and Sustainable Competitive Advantage. Academy of Management Review, 15(1), 88-102.

Regner, T. (2020). Crowdfunding a monthly income: an analysis of the membership platform Patreon. Journal of Cultural Economics, 45.

Reinert, H. & Reinert, E.S. (2006). Creative Destruction in Economics: Nietzsche, Sombart, Schumpeter. In Backhaus, J. & Drechsler, W. (Eds.), Friedrich Nietzsche, 1844-1900, Economy and Society. Berlin and New York: Springer.

Reuters. (2021). South Korea fines Google $177 million for blocking rival operating systems. Retrieved on 14 Sep. 2022, from Reuters. https://www.reuters.com/technology/skorean-antitrust-agency-fines-google-177-mln-abusing-market-dominance-2021-09-14/.

Rexaline, S. (2019). Intel Vs. AMD: Reviewing The Rivalry As CPU Market Shares Shift. Retrieved on 24 Nov 2020, from https://finance.yahoo.com/news/intel-vs-amd-reviewing-rivalry-160718187.html.

Ridester. (2023). Uber Drivers: Independent Contractors or Employees? Retrieved on 9 Apr. 2023, from https://www.ridester.com/uber-drivers-independent-contractors-employees/.

Ripple. (n.d.). The Role of Blockchain and Digital Assets in Cross-Border Payments. Retrieved on 24 Feb. 2021, from https://ripple.com/insights/the-role-of-blockchain-and-digital-assets-in-cross-border-payments/.

Roberts, P.W. & Amit, R. (2003). The Dynamics of Innovative Activity and Competitive Advantage: The Case of Australian Retail Banking, 1981 to 1995. Organization Science, 14(2), 206-224.

Robertson, H. (2021). The metaverse is a $1 trillion opportunity, crypto giant Grayscale says as virtual land sales boom. Market Insider. Retrieved on 1 Dec. 2021, from https://markets.businessinsider.com/news/currencies/metaverse-1-trillion-opportunity-grayscale-virual-land-sales-decentraland-2021-11.

Robertson, T.S. (1967). The Process of Innovation and the Diffusion of Innovation. Journal of Marketing, 31(1), 15-19.

Roblox. (2020). Explosive Lil Nas X Concert Paves the Way for Bold New Roblox Experiences. Roblox. Retrieved on 4 Aug. 2022, from https://blog.roblox.com/2020/12/explosive-lil-nas-x-concert-paves-way-bold-new-roblox-experiences/.

Roblox. (2021a). Gucci Garden. Roblox. Retrieved on 24 Aug. 2022, from https://www.roblox.com/games/6536060882/Gucci-Garden.

Roblox. (2021b). Roblox and Warner Bros. Pictures Bring in the Heights Launch Party to Roblox. Roblox. Retrieved on 14 Aug. 2022, from https://corp.roblox.com/2021/06/roblox-warner-bros-pictures-bring-heights-launch-party-roblox/.

Roblox. (2022). A Year On Roblox: 2021 In Data. Roblox. Retrieved on 17 Oct. 2022, from https://blog.roblox.com/2022/01/year-roblox-2021-data/.

Rocca, B. (2019). Introduction to Recommender Systems. Towards Data Science. Retrieved on 17 Oct. 2022, from https://towardsdatascience.com/introduction-to-recommender-systems-6c66cf15ada.

Rochet, J.C. & Tirole, J. (2003). Platform competition in Two-Sided Markets. Journal of the European Economic Association, 1(4).

Rochet, J.-C. & Tirole, J. (2006) Two-Sided Markets: A Progress Report. The RAND Journal of Economics, 37(3), 645-667.

Rockman, H. (2004). The Digital Millennium Copyright Act of 1998 (DMCA)-An Overview. In Intellectual Property Law for Business Lawyers (405-418). John Wiley & Sons.

Rogers, E. M. (1962). Diffusion of innovations. The Free Press of Glencoe Division of The Macmillan Co., New York, NY.

Rouge Media. (n.d.). The Rise of the Mobile Device and Its Effect on the Internet. Rouge Media Blog. Retrieved on 3 Jun. 2022, from https://www.rouge-media.com/blog/rise-mobile-device-effect-internet/.

Rumelt, R. P. (1984). Toward a strategic theory of the firm. In R. Lamb (Ed.), Competitive strategic management. Englewood Cliffs, New Jersey: Prentice-Hall.

Rutherford, M. (2001). Institutional Economics: Then and Now. Journal of Economic Perspectives, 15(3), 173-194.

Ryngaert, C. & Taylor, M. (2020). The GDPR as Global Data Protection Regulation? AJIL Unbound, 114, 5-9.

Rysman, M. (2009). The economics of two-sided markets. Journal of Economic Perspectives, 23(3).

Saarijärvi, H., Karjaluoto, H., & Kuusela, H. (2013). Customer relationship management: The evolving role of customer data. Marketing Intelligence & Planning, 31.

Salamander, G. (2022). The 9 Best Brands On Social Media. eclincher. Retrieved on 14 Dec. 2022, from https://eclincher.com/the-9-best-brands-on-social-media/.

Sanchez, R. & Heene, A. (1996). Introduction: towards the theory and practice of competence-based competition. In: Sanchez, R., Heene, A. & Thomas, H. (Eds.). Dynamics of competence-based competition: theory and practice in the new strategic management. Oxford, UK & New York: Pergamon, 1-35.

Sanchez, R., Heene, A. & Thomas, H. (1996). Dynamics of competence-based competition: theory and practice in the new strategic management. Oxford, UK & New York: Pergamon, 85-98.

Sautet, F. (2014). Ricardian Rents. Palgrave Encyclopedia of Management, 1-2.

Schiller, H. (1984). New information technologies and old objectives. Science and Public Policy, 11(6), 382-383.

Schmidt, G. M. & Druehl, C. T. (2008). When Is a Disruptive Innovation Disruptive. The Journal of Product Innovation Management, 25(4).

Schmidt, H. (2009). Competition law, innovation and antitrust: An analysis of tying and technological integration. Edward Elgar Publishing.

Schmidt, M. & Banusch, B. (2022). How will you seize real opportunities in tomorrow's virtual world? EY. Retrieved on 21 Mar. 2022, https://www.ey.com/en_ch/technology/how-will-you-seize-real-opportunities-in-tomorrows-virtual-world.

Schor, J., Walker, E., Lee, C., Parigi, P., & Cook, K. (2015). On the Sharing Economy. Contexts, 14(1), 12-19.

Schumpeter, J. A. (1934). The Theory of Economic Development: An Inquiry into Profits, Capital, Credit, Interest, and the Business Cycle. Transaction Books.

Schumpeter, J. A. (1939). Business Cycles: A Theoretical, Historical, and Statistical Analysis of the Capitalist Process. Volume 1. New York.

Schumpeter, J. A. (2003). Capitalism, Socialism and Democracy. Routledge London.

Scos.Training. (n.d.). The history of TCP/IP. Retrieved on 3 Jan. 2023, from https://scos.training/history-of-tcp-ip/.

Selznick, P. (1957). Leadership and Administration. Harper & Row.

Shahzadi, S., Iqbal, M., Qayyum, Z., & Dagiuklas, T. (2017). Infrastructure as a Service (IaaS): A Comparative Performance Analysis of Open-Source Cloud Platforms.

Shapiro, C. (1989). The Theory of Business Strategy. RAND Journal of Economics, 20(1).

Shapiro, C. (2012). Competition and Innovation: Did Arrow Hit the Bull's Eye? In J. Lerner & S. Stern (Eds.), The Rate and Direction of Inventive Activity Revisited. Chicago.

Shapiro, C., & Varian, H. R. (1989). Information Rules: A Strategic Guide to the Network Economy. Harvard Business Review Press.

Shengelia, N. (2020). Constitutionalizing Role of ToS of Social Media Platforms and Proposed Social Media User Bills of Rights. International Journal of Innovative Technologies in Social Science.

Shin, H. J., Pei, D., Lad, M., Choi, Y., & Zhang, L. (2005). The impact of multi-homing on network reliability and stability: A case study. In 2005 Proceedings of 14th International Conference on Computer Communications and Networks (543-548). IEEE.

Showstudio. (2021). Institute of Digital Fashion And Machine-a Take Fashion Retail Into The Future. Showstudio. Retrieved on 11 Feb. 2021, from, https://www.showstudio.com/news/institute-of-digital-fashion-and-machine-a-take-fashion-retail-into-the-future.

Shrivastava, P., Kulkarni, Dhanush, P., Chetan, B.S. & Shivaswamy, T. G. (2019). Recent Development of Automation in Vehicle Manufacturing Industries. International Journal of Innovative Technology and Exploring Engineering, 8, 410-413.

Sicoli, G. (2018). The Role of Intangibles in the Creation of Company Value. International Journal of Business and Management, 13, 161.

Simplilearn. (2023a). What is an Algorithm? Simplilearn. Retrieved on 23 Apr. 2023, from https://www.simplilearn.com/tutorials/data-structure-tutorial/what-is-an-algorithm.

Simplilearn. (2023b). Machine Learning Process: Steps, Frameworks, and Challenges. Simplilearn. Retrieved on 1 Apr. 2023, from https://www.simplilearn.com/tutorials/machine-learning-tutorial/machine-learning-steps.

Sinkovics, N. (2018). Pattern matching in qualitative analysis. In C. Cassell, A. Cunliffe, & G. Grandy (Eds.), The SAGE Handbook of Qualitative Business and Management Research Methods (Chapter 28, 468-485). SAGE, Thousand Oaks.

Sky News. (2021). Deliveroo riders set off flares outside company's London HQ in strike over pay and conditions. Retrieved on 29 Aug. 2022, from

https://news.sky.com/story/deliveroo-riders-set-off-flares-outside-companys-london-hq-in-strike-over-pay-and-conditions-12268664.

Slater, M., & Usoh, M. (1993). Presence in Immersive Virtual Environments. Proceedings of IEEE Virtual Reality Annual International Symposium, 90-96.

Smythe, D. W. (1981). On the Political Economy of Communications. Media, Culture & Society, 37(4), 497-515.

Snapchat. (2021). The Next Inflection Point: More Than 100 million Consumers Are Shopping with AR. Snapchat. Retrieved on 2 Feb. 2022, from, https://forbusiness.snapchat.com/blog/the-next-inflection-point-more-than-100-million-consumers-are-shopping-with-ar.

Soares, D., Freitas, H., Oliveira, J., Vieira, L., & Au-Yong Oliveira, M. (2022). Keeping the Eyes Busy: A Case Study of Disney+. In G. Gao & J. Liang (Eds.), HCI in Business, Government, and Organizations: eCommerce and Innovation (195-206). Springer.

Social Development Division. (2021). Inequality in Access to Information and Communication Technologies (ICTs) in East and North-East Asia and South-East Asia: Policy Paper. Economic and Social Commission for Asia and the Pacific.

Sombart, W. (1913). Studien zur Entwicklungsgeschichte des modernen Kapitalismus - Zweiter Band - Krieg und Kapitalismus. München, Duncker & Humblot. Retrieved on 11 Feb. 2018, from https://archive.org/details/kriegundkapitali00sombuoft.

Sousa, B., Pentikousis, K., & Curado, M. (2013). Multihoming: A Comprehensive Review. Advances in Computers, 90, 285-365.

Southard, E. (2021). Disney PhotoPass Service and Snap Collaboration Continues with New Augmented Reality Lenses at Walt Disney World Resort. Disney Parks Blog. Retrieved on 27 Oct. 2021, from https://disneyparks.disney.go.com/blog/2021/10/disney-photopass-service-and-snap-collaboration-continues-with-new-augmented-reality-lenses-at-walt-disney-world-resort/.

Southern, L. (2021). As Virtual and Physical Merge, Roblox Helps Brands Tap into Young People. Adweek. Retrieved on 28 Feb. 2021, from https://www.adweek.com/media/as-virtual-and-physical-merge-roblox-helps-brands-tap-into-young-people/.

Spangler, T. (2022). YouTube Ad Sales Hit $8.6 Billion in Q4, up 25% and Topping Netflix Revenue for Quarter. Variety. Retrieved on 11 Feb. 2022, from https://variety-com.cdn.ampproject.org/c/s/variety.com/2022/digital/news/youtube-q4-2021-advertising-netflix-revenue-1235168995/amp/.

Spiceworks. (2023). Simple Mail Transfer Protocol (SMTP). Retrieved on 2 Apr. 2023, from https://www.spiceworks.com/tech/networking/articles/simple-mail-transfer-protocol-smtp/.

Srnicek, N. and Williams, A. (2015). Inventing the Future: Postcapitalism and a World Without Work. Verso Books.

Stack Overflow Blog. (2020,). A Practical Guide to Writing Technical Specs. Retrieved on 6 Jul. 2022, from https://stackoverflow.blog/2020/04/06/a-practical-guide-to-writing-technical-specs/.

Starbuck, W. (2003). The Origins of Organization Theory. In The Oxford Handbook of Organization Theory (143-182).

Statcounter. (2020a). Mobile Operating System Market Share Worldwide. Retrieved on 2 Mar. 2020, from https://gs.statcounter.com/os-market-share/mobile/worldwide.

Statcounter. (2020b). Search Engine Market Share Worldwide 2020. Retrieved on 2 Mar. 2020, from https://gs.statcounter.com/search-engine-market-share.

Statista. (2021a). Worldwide internet users by browser. Statista. Retrieved on 2 Mar. 2022, from https://www.statista.com/statistics/543218/worldwide-internet-users-by-browser/.

Statista. (2021b). Top 20 most viewed YouTube videos of all time worldwide as of December 2020. Retrieved on 1 Apr. 2023, from https://www.statista.com/statistics/249396/top-youtube-videos-views/.

Statista. (2018a). E-commerce market share of leading e-retailers worldwide in 2018, based on GMV. Retrieved on 3 Sep. 2022, from https://www.statista.com/statistics/664814/global-e-commerce-market-share/.

Statista. (2019a). Global market revenue share of leading smartphone applications processor vendors in 2014 to 2019. Retrieved on 12 Jun. 2022, from https://www.statista.com/statistics/233415/global-market-share-of-applications-processor-suppliers/.

Statista. (2019b). Number of available apps in the Apple App Store from 2008 to 2019 (in 1,000s). Retrieved on 10 Jul. 2022, from https://www.statista.com/statistics/268251/number-of-apps-in-the-itunes-app-store-since-2008/.

Statista. (2020a). Share of households with a computer at home worldwide from 2005 to 2019. Statista. Retrieved on 13 Jun. 2021, from https://www.statista.com/statistics/748551/worldwide-households-with-computer/.

Statista. (2020b). Annual revenue of Google from 2002 to 2019 (in billion U.S. dollars). Retrieved on 22 Jul. 2020, from https://www.statista.com/statistics/266206/googles-annual-global-revenue/.

Statista. (2020c). Leading online companies ranked by revenue from 2017 to 2019 (in billion U.S. dollars). Retrieved on 10 Jul. 2020, from https://www.statista.com/statistics/277123/internet-companies-revenue/.

Statista. (2020d). Number of available applications in the Google Play Store from December 2009 to June 2020. Retrieved on 10 Jul. 2020, from https://www.statista.com/statistics/266210/number-of-available-applications-in-the-google-play-store/.

Statista. (2020e). Estimated number of SVOD subscribers worldwide in 2020 and 2025, by service (in millions). Retrieved on 10 Jul. 2020, from https://www.statista.com/statistics/1052770/global-svod-subscriber-count-by-platform/.

Statista. (2020f). Android - Statistics & Facts. Retrieved on 11 Jul. 2020, from https://www.statista.com/topics/876/android/.

Statista. (2020g). Global market share held by leading internet browsers from January 2012 to June 2020. Retrieved on 18 Jul. 2020, from https://www.statista.com/statistics/268254/market-share-of-internet-browsers-worldwide-since-2009/.

Statista. (2020h). Global market share of cloud infrastructure services from 2017 to 2020, by vendor. Retrieved on 28 Jul. 2020, from https://www.statista.com/statistics/477277/cloud-infrastructure-services-market-share/.

Statista. (2020i). E-commerce share of total global retail sales from 2015 to 2023. Retrieved on 14 Aug. 2020, from https://www.statista.com/statistics/534123/e-commerce-share-of-retail-sales-worldwide/.

Statista. (2020j). Worldwide largest B2C e-commerce markets in 2015-2016. Statista. Retrieved on 12 Aug 2020, from https://www.statista.com/statistics/274493/worldwide-largest-e-commerce-markets-forecast/.

Statista. (2020k). Retail e-commerce sales worldwide from 2014 to 2023. Retrieved on 14 Aug. 2022, from https://www.statista.com/statistics/379046/worldwide-retail-e-commerce-sales/.

Statista. (2022a). Most popular social networks worldwide as of January 2022, ranked by number of monthly active users (in millions). Retrieved on 3 Aug. 2022, from https://www.statista.com/statistics/272014/global-social-networks-ranked-by-number-of-users/.

Statista. (2022b). Number of active advertisers on Facebook from 1st quarter 2016 to 3rd quarter 2020 (in millions). Retrieved on 14 May 2022, from https://www.statista.com/statistics/778191/active-facebook-advertisers/.

Statista. (2022c). Subscriber share of music streaming services worldwide as of Q2 2022. Retrieved on 19 Oct. 19, 2022, from https://www.statista.com/statistics/653926/music-streaming-service-subscriber-share/.

Statista. (2023a). Mobile operating systems' market share worldwide from 1st quarter 2009 to 4th quarter 2022. Retrieved on 26 Jan. 2022, from https://www.statista.com/statistics/272698/global-market-share-held-by-mobile-operating-systems-since-2009/.

Stephenson, N. (2000). Snow Crash. Random House Publishing Group.

Stjernfelt, F., & Lauritzen, A. (2020). Facebook's Handbook of Content Removal. In C. Petersen & S. W. Seidenfaden (Eds.), The Content Ecosystem: Elites and Digitalization (115-137). Springer.

Subramanian, A. & Nilakanta, S. (1996). Organizational Innovativeness: Exploring the Relationship Between Organizational Determinants of Innovation, Types of Innovations, and Measures of Organizational Performance. Omega, 24(6).

Sun, M. & Tse, E. (2007). When Does the Winner Take All in Two-Sided Markets? Review of Network Economics. 6, 16-41.

Sundu, M., Yaşar, O., & Fındıklı, M. (2022). Data-Driven Innovation: Digital Tools, Artificial Intelligence, and Big Data. In F. J. Martínez-López, R. del Aguila-Obra, & M. P. García-Sabater (Eds.), Handbook of Research on Entrepreneurship and Innovation (149-175). Springer International Publishing.

Susen, S. (2020). No escape from the technosystem? Philosophy & Social Criticism, 46(6), 734–782.

Svetlova, E. (2008). Innovation als soziale Sinnstiftung. In P. Seele (Ed.), Philosophie des Neuen. Darmstadt: WBG.

Taherdoost, H. (2023). Smart Contracts in Blockchain Technology: A Critical Review. Information, 14(2), 117.

Tassi, P. (2021). Fortnite's NBA Skins Are The Future Of Marketing. Forbes. Retrieved on 23 Jul. 2021, from https://www.forbes.com/sites/paultassi/2021/05/21/fortnites-nba-skins-are-the-future-of-marketing/.

Tayar, D., & El Khanchoufi, J. (2022). The Neighbouring Rights Saga (France): Google Fined €500 million for Breaching Interim Order to Negotiate in Good Faith With News Agencies and Publishers. Journal of European Competition Law & Practice, 13(5), 355–359.

TechCrunch. (2014). Google Acquires DeepMind, An Artificial Intelligence Startup From London, Reportedly For $400M. Retrieved on 3 Mar. 2022, from https://techcrunch.com/2014/01/26/google-deepmind/.

TechCrunch. (2023). Tech industry layoffs. Retrieved on 2 Apr. 2023, from https://techcrunch.com/2023/04/07/tech-industry-layoffs/.

Technavio. (2021). Global Music Streaming Market 2021-2025. Retrieved on 29 Nov. 2021, from https://www.technavio.com/report/music-streaming-market-industry-analysis.

Techopedia. (2020). Universal Serial Bus (USB) - Definition. Retrieved on 6 Jul. 6, 2022, from https://www.techopedia.com/definition/2320/universal-serial-bus-usb.

TechTarget. (n.d.). Internet of Things (IoT). IoT Agenda. Retrieved on 6 Apr. 2022, from https://internetofthingsagenda.techtarget.com/definition/Internet-of-Things-IoT.

Teece, D. J. & Pisano, G. P. (1994). The Dynamic Capabilities of Firms: An Introduction. International Institute for Applied Systems Analysis Working Paper 94-103.

Teece, D. J. (1984). Economic Analysis and Strategic Management. California Management Review, 26(3).

Teece, D. J. (2007). Explicating dynamic capabilities: the nature and microfundations of (sustainable) enterprise performance. Strategic Management Journal, 28(13).

Teece, D. J. (2010). Business Models, Business Strategy and Innovation. Long Range Planning, 43(2-3).

Teece, D. J., Pisano, G. P., & Shuen, A. (1997). Dynamic capabilities and strategic management. Strategic Management Journal, 18(7).

Tellis, G. J. (2005). Disruptive Technology or Visionary Leadership. Journal of Product Innovation Management, 23(1).

TELUS International. (2022). The Difference Between CNN and RNN: Which One to Use for NLP? TELUS International. Retrieved on 29 Mar. 2023, from https://www.telusinternational.com/insights/ai-data/article/difference-between-cnn-and-rnn.

TermsFeed. (2021). LGPD vs GDPR - What are the differences? Retrieved on 12 Jan. 2022, from https://www.termsfeed.com/blog/lgpd-vs-gdpr/.

The Canadian Encyclopedia. (n.d.). BlackBerry Limited. Retrieved on 7 Apr 2023, from https://www.thecanadianencyclopedia.ca/en/article/blackberry-limited.

The Guardian. (2016). Virtual reality: A guide to VR headsets, apps and games. Retrieved on 3 Jan. 2023, from https://www.theguardian.com/technology/2016/nov/10/virtual-reality-guide-headsets-apps-games-vr.

The Guardian. (2019). Uber and Lyft drivers strike in US cities to mark IPOs. Retrieved on 16 Feb. 2021, from https://www.theguardian.com/technology/2019/may/08/uber-lyft-strikes-us-new-york-la-latest-news-updates.

The Guardian. (2020). Influencers are being taken advantage of: the social media stars turning to unions. Retrieved on 23 Oct. 2021, from https://www.theguardian.com/media/2020/oct/10/influencers-are-being-taken-advantage-of-the-social-media-stars-turning-to-unions.

The New York Times. (2023). Meta cuts jobs and reorganizes management in effort to streamline operations. Retrieved on 13 Apr. 2023, from https://www.nytimes.com/2023/04/12/technology/meta-layoffs-employees-management.html.

The Verge. (2020). EU opens Apple antitrust investigations into App Store and Apple Pay practices. Retrieved on 5 Jul. 2020, from https://www.theverge.com/2020/6/16/21292651/apple-eu-antitrust-investigation-app-store-apple-pay.

The Verge. (2023). Microsoft and OpenAI extend partnership to make GPT-3 available to Azure customers. Retrieved on 3 Mar. 2023, from https://www.theverge.com/2023/1/23/23567448/microsoft-openai-partnership-extension-ai.

Thiel, P., & Masters, B. (2014). Zero to One: Notes on Start-Ups, or How to Build the Future. Random House.

ThinkImpact (2022). WhatsApp Statistics 2021. ThinkImpact.

Thomond, P., & Lettice, F. (2002). Disruptive Innovation Explored. Concurrent Engineering Conference Proceedings, Research and Applications.

Thompson Intelligence. (2021). Into the Metaverse. Wunderman Thompson.

Tidd, J. (2001). Innovation management in context: environment, organization and performance. International Journal of Management Reviews, 3(3).

Tidd, J., & Bessant, J. R. (2013). Managing Innovation: Integrating Technological, Market, and Organizational Change (5th Ed.). Wiley.

TikTok. (n.d.a). TikTok Nutzungsbedingungen. Retrieved on 4 Mar 2021, from https://www.tiktok.com/legal/page/eea/terms-of-service/de-DE.

TikTok. (n.d.b). Community Guidelines. Retrieved on 9 Nov 2022, from https://www.tiktok.com/community-guidelines?lang=en.

Tilic, G. (2017). Snapchat as an Advertising Platform. New Trends and Issues Proceedings on Humanities and Social Sciences, 4, 122.

Topelson, D., Bavitz, C., Gupta, R., & Oberman, I. (2013). Privacy and Children's Data - An Overview of the Children's Online Privacy Protection Act and the Family Educational Rights and Privacy Act. SSRN Electronic Journal.

Trabucchi, D., & Buganza, T. (2019). Fostering digital platform innovation: From two to multi-sided platforms. Creativity and Innovation Management, 29.

Tracxn. (2022). Top AI Infrastructure Startups - 2022. Tracxn. Retrieved on 2 Apr. 2023, from https://tracxn.com/d/emerging-startups/top-ai-infrastructure-startups-2022.

Uber (2020). Use Uber in cities around the world. Retrieved on 14 Oct. 2021, from https://www.uber.com/global/en/cities/.

Ukav, İ. (2017). Market Structures and Concentration Measuring Techniques. Asian Journal of Agricultural Extension, Economics & Sociology, 19, 1-16.

Ullah, A., Baharun, R., Nor, K., & Yasir, M. (2018). Overview of Enterprise Resource Planning (ERP) System in Higher Education Institutions (HEIs). Advanced Science Letters, 24(6), 4399-4406.

UpGuard. (2023). What is UPnP? Retrieved on 14 Apr. 2023, from https://www.upguard.com/blog/what-is-upnp.

Utterback, J. M. (1996). Mastering the Dynamics of Innovation. Harvard Business Review Press, Boston, MA. 2nd Edition.

Utterback, J. M., & Abernathy, W. J. (1975). A Dynamic Model of process and product innovation.

V7labs. (2023). A Comprehensive Guide to Transfer Learning. V7labs Blog. Retrieved on 7 Apr. 2023, from https://www.v7labs.com/blog/transfer-learning-guide/.

van der Vlist, F., Burkhardt, M., Helmond, A., & Seitz, T. (2020). The Evolution of Facebook's Graph API. In AoIR Selected Papers of Internet Research.

Vanhaelen, Q., Moskalev, A., Mamoshina, P., Scheibye-Knudsen, M., & Zhavoronkov, A. (2018). Artificial Intelligence for Aging and Longevity Research: Recent Advances and Perspectives. Ageing Research Reviews.

Varian, H. (2018). Artificial Intelligence, Economics, and Industrial Organization. National Bureau of Economic Research, Cambridge, Massachusetts.

Varun, D. (2018). How Will 100 Million Independent Workers Find & Manage Work In 2030. Medium. Retrieved on 10 Jul. 2019, from https://medium.com/@startuphackers/how-will-100-million-independent-workers-find-manage-work-in-2030-51b21ca40343.

Verhoef, P., Broekhuizen, T., Bart, Y., Bhattacharya, A., Dong, J., Fabian, N., & Haenlein, M. (2021). Digital transformation: A multidisciplinary reflection and research agenda. Journal of Business Research, 122.

Vilone, G. and Longo, L. (2020). Explainable Artificial Intelligence: a Systematic Review.

Visualise. (2021). Capital WebAR Experience with Anne-Marie. Visualise. Retrieved on 2 Feb. 2022, from, https://visualise.com/case-study/capital-webar-experience-with-anne-marie.

Vitton, J., Schultz, P., & Butz, N. (2014). Eastman Kodak: Facing disruptive technological change. Journal of Critical Incidents, 7, 63-66.

Vlassis, A. (2017). The review of the Audiovisual Media Services Directive: Many political voices for one digital Europe? Politique européenne, (4), 102-128.

Voštinár, P., Horváthová, D., Mitter, M., & Bako, M. (2021). The Look at the Various Uses of VR. Open Computer Science, 11(1), 137-146.

Vujičić, D., Jagodic, D., & Ranđić, S. (2018). Blockchain technology, bitcoin, and Ethereum: A brief overview. In 2018 15th International Scientific Conference on Informatics and Information Technologies (INFOTEH) (1-6). IEEE.

w3schools.com. (n.d.). JavaScript JSON. Retrieved on 12 Feb. 2023, from https://www.w3schools.com/js/js_json_intro.asp.

Wagner, B., Rozgonyi, K., Sekwenz, M.-T., Cobbe, J., & Singh, J. (2020). Regulating Transparency? Facebook, Twitter and the German Network Enforcement Act. In Proceedings of the 2020 CHI Conference on Human Factors in Computing Systems (1-13).

Walter, B., & Hess, T. (2003). iTunes Music Store - An innovative service to enforce properly rights in the internet. Business and Information Systems Engineering, 45(6), 541-546.

Wang, X. & Yang, B. (2001). Fixed and Sunk Costs Revisited. Journal of Economic Education, 32(2), 178-185.

Wang, Y., Wang, B., Yan, Y., & Zhang, J. (2021). The Clearer Timelines, the Better? Evidence From Kickstarter. IEEE Transactions on Engineering Management, 1-14.

Wang, Z., Liu, J., & Zhu, W. (2016). Popularity of Social Videos. In T. Mei, X. Cheng, Y. Liu, & T. Zhang (Eds.), Social Media Retrieval (7-21). Springer International Publishing.

WCCF Tech. (2022). Google, Facebook, and Other Big Tech Companies to Be Under More Scrutiny. Retrieved on 6 Jul. 2022, from https://wccftech.com/google-facebook-and-other-big-tech-companies-to-be-under-more-scrutiny/.

Weber, M. (1978). Economy and Society - An Outline of Interpretive Sociology. Berkeley, CA: University of California Press.

Weiner, E. (2016). Renaissance Florence Was a Better Model for Innovation than Silicon Valley Is. Harvard Business Review, Retrieved on 9 Jan. 2021, from https://hbr.org/2016/01/renaissance-florence-was-a-better-model-for-innovation-than-silicon-valley-is.

Weinman, J. (2015). Netflix-Entertaining Disruption. In T. Clark & A. Mang (Eds.), Cases in Corporate Sustainability and Change: A Multidisciplinary Approach (197-210). John Wiley & Sons.

Weinstein, A. (2018). Customer Value Metrics. In Handbook of Research on Customer Equity in Marketing (157-174). Routledge.

Wernerfelt, B. (1984). A Resource-based View of the Firm. Strategic Management Journal, 5, 171-180.

Westerlund, M., Isabelle, D., & Leminen, S. (2021). The Acceptance of Digital Surveillance in an Age of Big Data. Technology Innovation Management Review, 11, 32-44.

White, S. (2020). Amazon and WholeFoods: Adventures in Grocery Shopping. The CASE Journal, ahead-of-print.

Widmer, B. (2022). How the Google Search Algorithm Works in 2022: The Ultimate Guide. Ahrefs. Retrieved on 17 Oct. 2022, from https://ahrefs.com/blog/google-search-algorithm/.

Wielsch, D. (2018). Die Ordnungen der Netzwerke. AGB - Code - Community Standards: Die Zukunft des NetzDG und seine Folgen für die Netzwerkkommunikation. In U. Bernhard, J. Seibel, & J. Zienicke (Eds.), Kommunikation, Medien und politische Bildung im digitalen Zeitalter (61-94). Nomos Verlagsgesellschaft mbH & Co. KG.

Wilkinson, D., & Thelwall, M. (2010). Social network site changes over time: The case of MySpace. Journal of the American Society for Information Science and Technology, 61(11), 2311-2323.

Williams, R. (2002). Review: Lewis Mumford's Technics and Civilization. Technology and Culture, 43(1), 139-149.

Wilson, S. (2021). Where Brands Are Reaching Gen Z. Harvard Business Review. Retrieved on 22 Nov. 2021, from https://hbr.org/2021/03/where-brands-are-reaching-gen-z.

Wind, J., & Mahajan, V. (1981). Market Share: Concepts, Findings, and Directions for Future Research. In B. M. Enis & K. J. Roering (Eds.), Review of Marketing 1981 (31-42). American Marketing Association.

Winner, L. (2020). The Whale and the Reactor: A Search for Limits in an Age of High Technology. Chicago and London: The University of Chicago Press. 2nd Ed.

Wirtz, J., So, K. K. F., Mody, M., Liu, S., & Chun, H. (2019). Platforms in the Peer-to-Peer Sharing Economy. Journal of Service Management, 30(3), 452-483.

Witt, U., & Chai, A. (Eds.). (2019). Understanding Economic Change. Advances in Evolutionary Economics. Cambridge, UK: Cambridge University Press.

Wong, D.T., Kong, P-Y., Liang, Y-C., Chua, K.C. (2009). Wireless Broadband Networks. John Wiley & Sons.

Wootton, C. (2021a). Digital Designers Can Unlock Your Brand's Potential in the Virtual World. Adweek. Retrieved on 25 Aug. 2021, from https://www.adweek.com/brand-marketing/digital-designers-can-unlock-your-brands-potential-in-the-virtual-world/.

Wootton, C. (2021b). The Biggest Opportunity for Sustainable Brands? Roblox Points to Virtual Goods. Adweek. Retrieved on 5 Sep. 2021, from https://www.adweek.com/brand-marketing/the-biggest-opportunity-for-sustainable-brands-roblox-points-to-virtual-goods/.

Wootton, C. (2021c). Roblox Reinvents Virtual Spaces That Aren't Mere Digital Copies. Adweek. Retrieved on 15 Sep. 2021, from https://www.adweek.com/brand-marketing/roblox-reinvents-virtual-spaces-that-arent-mere-digital-copies/.

World Bank. (2018). Blockchain and Distributed Ledger Technology. Retrieved 8 May 2022, from https://www.worldbank.org/en/topic/financialsector/brief/blockchain-dlt.

World Bank. (2020). Annual Report. World Bank.

World Economic Forum. (2023). Why nurturing talent is key to riding out the recession. World Economic Forum. Retrieved on 3 Apr. 2023, from https://www.weforum.org/agenda/2023/01/why-nurturing-talent-is-key-to-riding-out-the-recession-davos23/.

World of VR. (n.d.). Spark AR Studio. Retrieved on 3 Nov. 2022, from https://worldofvr.de/spark-ar-studio/.

Wróbel, G., & Wikira, M. (2019). Overview of Big Data platforms. Journal of Computer Sciences Institute, 13, 283-287.

Xiong, Z., Niyato, D., & Wang, P. (2018). Network Effects. In Encyclopedia of Wireless Networks (1-8). Springer International Publishing.

Yasrab, R. (2018). Platform-as-a-Service (PaaS): The Next Hype of Cloud Computing.

Yin, R. K. (2003). Case study research: Design and methods (3rd Ed.). SAGE Publications, Inc. Thousand Oaks and London and New Delhi.

YouTube About. (2020). YouTube for press. YouTube About. Retrieved on 4 Aug. 2020, from https://www.youtube.com/intl/en-GB/about/press/.

Yu, D., & Hang, C. C. (2008). A reflective review of disruptive innovation theory. International Journal of Management Reviews, 12(4).

Yuan, A. & Gao, L. (2021). Research on the Application of NLP Artificial Intelligence Tools in University Natural Language Processing. IOP Conference Series: Earth and Environmental Science, 714.

Zak. (2019). The New Rules of Social. Zakagency.

Zhang, H., Wang, Z. Q., Liu, W., & Tan, Z. (2012). The Design of Arithmetic Logic Unit Based on ALM. Procedia Engineering, 29, 1969-1973.

Zhe, G. (2019). Artificial Intelligence and Consumer Privacy. In A. Agrawal, J. Gans, & A. Goldfarb (Eds.), Economics of Artificial Intelligence: An Agenda (Chicago: University of Chicago Press).

Zheng, Z., Shaoan, X., Hong-Ning, D., Xiangping, C., & Huaimin, W. (2017). An Overview of Blockchain Technology: Architecture, Consensus, and Future Trends. In 2017 IEEE International Congress on Big Data (BigData Congress), 557-564. IEEE.

Zolfaghari, B., Srivastava, G., Roy, S., Nemati, H., Afghah, F., Koshiba, T., Razi, A., Bibak, K., Mitra, P., & Rai, B. (2020). Content Delivery Networks: State of the Art, Trends, and Future Roadmap. ACM Computing Surveys, 53, 1-34.