The rocket boost of Digital Healthcare startups

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Abstract

This article presents a strategic analysis of the digital startup ecosystem in the Digital Healthcare sector. The background of the work is based on the rapid evolution and potential benefits offered by Digital Healthcare, including improved access to care and enhanced patient outcomes. The methods employed include a market study of the subcategories within Digital Healthcare and the analysis of data extracted from Forbes using Python for web scraping. The results encompass a technical analysis from 140 digital healthcare startups to 8 Telemedicine startups to a successful startup through the application of strategic analysis and algorithms. Future developments involve a detailed analysis of the digital startup ecosystem in the Digital Healthcare sector specifically in Italy. This study provides an in-depth overview of the digital startup ecosystem in Digital Healthcare and outlines future perspectives for research and development in the field.

1 Introduction to Digital Healthcare

The Digital Healthcare sector has experienced explosive growth in recent years, offering a wide range of opportunities and radically transforming the way healthcare is delivered[3]. With the advent of digital technologies such as telemedicine, digital diagnostics, and digital therapeutics, access to healthcare services has been improved, clinical processes have become more efficient, and better outcomes for patients have been achieved[7].

The digitization of healthcare has opened up new horizons, enabling remote communication between doctors and patients, rapid access to test results, electronic management of medical records, and remote health monitoring. These innovations have enhanced the efficiency and timeliness of care, reduced costs, and provided personalized and high-quality assistance[9].

Moreover, digitization has created a wealth of opportunities in the Digital Healthcare sector. Innovative startups and technology companies are developing groundbreaking solutions, including mobile applications, wearable devices, and advanced algorithms, to improve diagnosis, treatment, and disease management. This rapidly growing sector is attracting increasing investments and the interest of healthcare professionals, entrepreneurs, and investors[12].

Healthcare profit pools are projected to reach $790 billion in 2026, growing at a 4% CAGR from $654 billion in 2021. Notably, software and platforms, such as clinical decision support platforms, will experience higher growth*. The utilization of digital health technology has also significantly increased, with a growth rate of +32% in April 2020†. Although utilization levels have since stabilized, ranging from 13% to 17% across all specialties, the potential for further growth and adoption of digital health solutions remains significant.

*https://www.mckinsey.com/industries/healthcare/our-insights/telehealth-a-quarter-trillion-dollar-post-covid-19-reality

†https://www.mckinsey.com/industries/healthcare/our-insights/what-to-expect-in-us-healthcare-in-2023-and-beyond

In 2021, the total funding among US-based digital health startups amounted to $29.1 billion across 729 deals, with an average deal size of $39.9 million. This represents a doubling of investment compared to the previous record of $14.9 billion in 2020. Notably, mental healthcare startups secured the highest funding, raising $5.1 billion, indicating the increasing importance and demand for virtual options in mental and behavioral health services[‡].

The promising growth and substantial investments in the Digital Healthcare sector highlight its potential for transformative change in the healthcare landscape. However, as the sector continues to evolve, challenges related to data security, privacy, and regulatory frameworks need to be addressed[14]. Therefore, it is crucial to thoroughly understand the context and dynamics of the sector in order to fully leverage the opportunities offered by Digital Healthcare and ensure a positive impact on people's health.

1.1 Literature Industry Classification

In order to gain a comprehensive understanding of the Digital Healthcare sector, it is essential to classify and analyze the existing literature. To classify the literature effectively, we propose an industry-based classification approach[15]. This approach categorizes the literature according to the following five sectors and domains within Digital Healthcare:

- Telemedicine and Remote Monitoring: This category includes studies focusing on remote communication between healthcare providers and patients, as well as the use of digital technologies for monitoring patients' health remotely. Topics covered may include teleconsultation, telemonitoring, and teletriage.

- Digital Diagnostics: This category encompasses literature related to the use of digital technologies for diagnostic purposes. It includes research on digital imaging, digital pathology, digital biomarkers, and other digital diagnostic tools[1].

- Digital Therapeutics: This category includes studies that explore the use of digital technologies, such as mobile apps and software programs, for the treatment and management of various health conditions. It covers areas such as digital therapeutics for mental health, chronic disease management, and behavior change interventions.

- Health Data Analytics and Artificial Intelligence: This category focuses on literature that discusses the application of data analytics and artificial intelligence (AI) techniques in healthcare. It includes research on data mining, machine learning, predictive modeling, and decision support systems for healthcare.

- Health Information Systems and Electronic Health Records: This category includes literature on the development and implementation of health information systems, electronic health records (EHRs), and other digital platforms for storing, managing, and exchanging healthcare data[11].

By organizing the literature into these five categories, researchers, practitioners, and policymakers can navigate the vast landscape of Digital Healthcare literature more effectively. This classification framework provides a structured approach to identify relevant research within specific sectors of Digital Healthcare, enabling a focused analysis of key findings, trends, challenges, and opportunities within each domain[5].

Through this classification framework, we aim to facilitate knowledge synthesis, identify research gaps, and support the development of targeted research agendas. By gain-

[‡]https://rockhealth.com/insights/2021-year-end-digital-health-funding-seismic-shifts-beneath-the-surface/

ing a deeper understanding of the literature in each sector, we can advance the field of Digital Healthcare and drive innovation in healthcare delivery, patient outcomes, and system efficiency.

1.2 Contribution and Project description

This project aims to conduct an in-depth analysis of the HealthTech Unicorn startup market in the digital healthcare sector. The analysis will commence with data extraction from Forbes using the Python programming language and web scraping techniques. Subsequently, a technical analysis will be performed on a sample of 140 startups, with a particular focus on eight companies active in the telemedicine field. These eight startups will undergo a comparison based on strategic analysis and advanced algorithms to identify the startup with the highest potential for success. The business model of the selected startup will then be subject to a thorough analysis. Finally, the obtained results will be critically and functionally interpreted using strategic analysis tools, and the collected data will be presented in a visually intuitive manner to facilitate a better understanding of industry dynamics.

2 Focus on Unicorn: An In-depth Analysis of the HealthTech Digital Healthcare Startup Market

2.1 Technical Pipeline to create a strategic analysis

This chapter focuses on the technical process used to create a strategic analysis of startups in the digital healthcare sector as shown in Fig. 1. Specifically, the startups under consideration were identified through web scraping using Python and Selenium, extracting data on HealthTech Unicorn startups from the period of 2022-2023 from this website.

From the website, we extracted several variables of interest for our analysis, including the company name, year of establishment, country of origin, industry sector, macro-industry sector, last funding round, round type, and valuation. These variables provide an initial overview of the startups considered and enable us to identify the 8 companies focused on telemedicine that will be subjected to more detailed analysis.

Subsequently, we enriched our dataset by adding additional information using electronic resources such as ORBIS and GlobalData Explorer. These databases provided us with the opportunity to obtain other specific variables of interest to evaluate the selected telemedicine companies. To highlight this information, we will create two tables.

- The first set of information provides insights into various key aspects of the telemedicine companies. It includes details such as the company name, year of establishment, country of origin, industry and macro-industry classification, details of the most recent funding round, the funding amount received in the last round, the valuation of the company, the number of investors associated with the company, and the number of acquisitions made by the company.

- On the other hand, the second set of information focuses on specific variables related to the companies' operations. It includes the number of employees in each company, the availability of job offers in May 2022, November 2022, and May 2023, the geographical locations where the companies have job opportunities, details about the funding rounds, and the type of each funding round.

Later, in order to facilitate further analysis using Python libraries such as NumPy and Pandas, the extracted variables from both sources were combined into a single table. This consolidated table will provide a comprehensive and unified dataset, enabling seamless data manipulation and exploration using powerful analytical tools.

By merging the information from multiple sources into a single table, we ensure that all relevant variables are readily available for analysis. This consolidated approach simplifies data handling and allows for more efficient processing, enabling us to derive valuable insights and draw meaningful conclusions from the collected data.

These sets of information allow for a comprehensive understanding of the telemedicine companies' profiles, financial aspects, and operational dynamics. They enable comparisons and analyses of variables such as funding, company valuation, investor involvement, job opportunities, and geographic presence. By examining these variables, patterns, strengths, and areas for potential growth or improvement can be identified within the telemedicine sector.

In the following sections of the chapter, we will analyze the results derived from this strategic analysis, discuss the implications, and draw key conclusions. The aim is to provide an in-depth overview of startups in the telemedicine sector and objectively identify and analyze a successful business model using quantitative algorithms for startup evaluation.

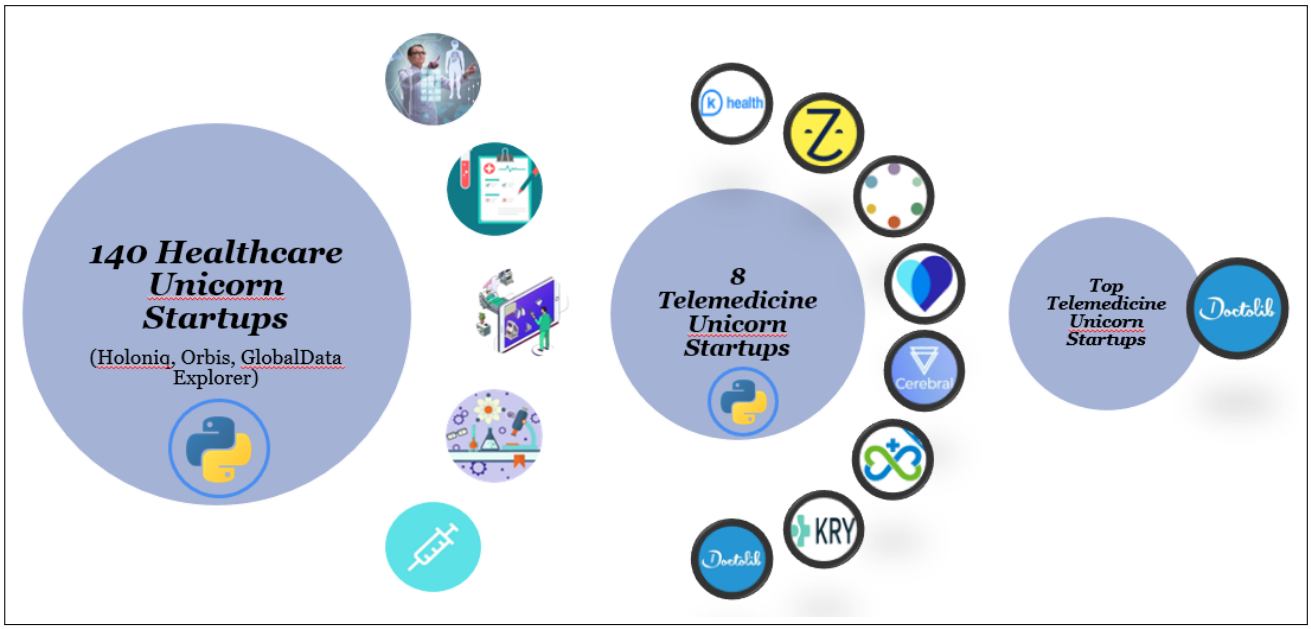

Figure 1: Technical Pipeline of the project from 140 healthcare startups to 8 telemedicine startups to a successful startup.

2.2 Data Collection from 140 Digital Health startups to 8 Telemedicine startups

In this chapter, our focus is on the field of telehealth within the digital healthcare sector. We have specifically chosen to analyze eight telehealth startups from a pool of 140 companies. The sector of TeleHealth was selected based on two primary reasons:

1. Significant Growth Potential: We recognized the substantial growth potential in the telehealth sector, particularly in the post-COVID era. As the de-

mand for telehealth services continues to rise and technology advancements support its expansion, this sector presents a promising opportunity for startups.

2. Impressive Compound Annual Growth Rate (CAGR): The telehealth market is expected to experience a remarkable compound annual growth rate (CAGR) of 32.1% from 2021 to 2028. This robust growth rate demonstrates the sector's resilience and long-term viability, making it an attractive domain for startup ventures.

Furthermore, we deliberately selected startups from different continents and varying stages of the startup life cycle. This intentional approach allows for a comprehensive analysis that encompasses diverse perspectives and enables insightful comparisons. By examining these startups' strategies, market positioning, and potential for success, we aim to gain a comprehensive understanding of the telehealth landscape.

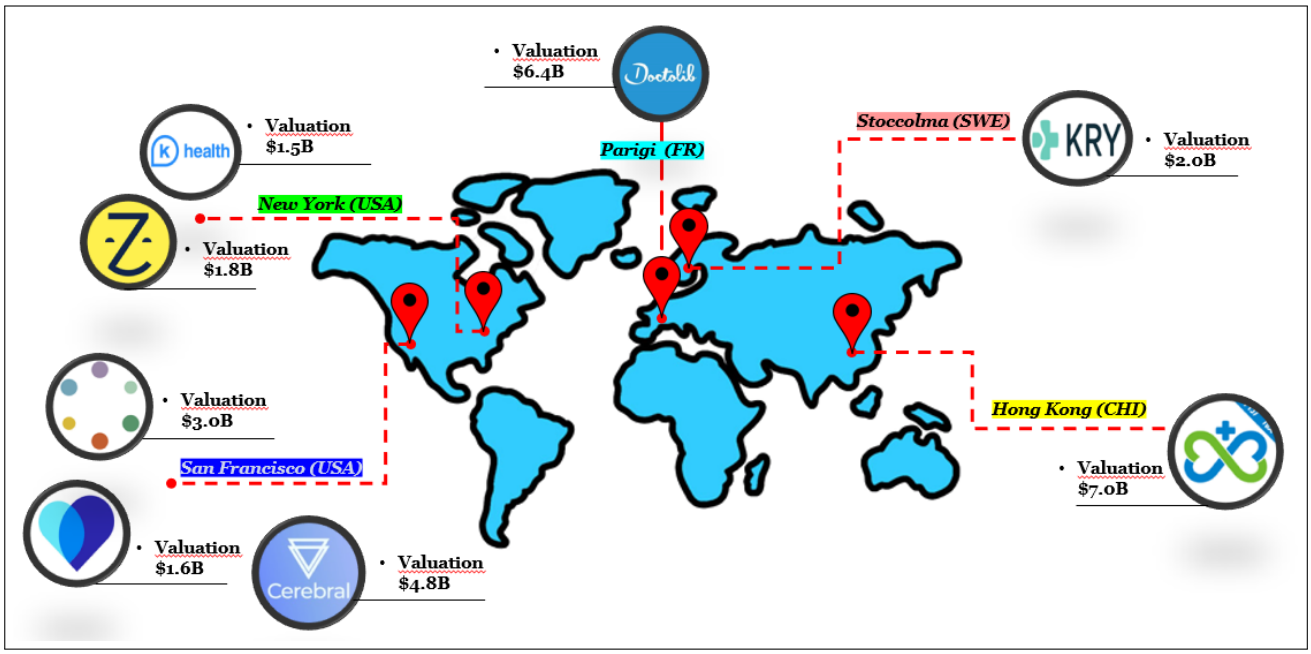

Figure 2: Strategic Map of Country and Valuation of best 8 Telemedicine startups considered in my analysis

Throughout our analysis, we have conducted various strategic assessments to gain comprehensive insights into the selected 8 telehealth startups. Specifically, these analyses aim to find a successful case of telehealth startups based on objective and quantitative parameters. These analyses include:

PESTEL Analysis: The telehealth sector is subject to a comprehensive examination using a PESTEL framework, which considers several key factors that impact the adoption and growth of telehealth solutions. These factors include:

- **P** Regulation & Healthcare Policies: Governmental laws and regulations play a significant role in shaping the telehealth landscape. Factors such as data privacy norms and national policies can influence the adoption and implementation of telemedicine practices.
- **E** Healthcare Costs: The rising costs of healthcare services and the strain

on healthcare systems worldwide have prompted the exploration of more cost-effective alternatives. In addition, the flow of investments in telemedicine technologies and infrastructure plays a crucial role in shaping the telehealth landscape.

- **S** Cultural Acceptance and Access to Care: Cultural beliefs and patient expectations can significantly impact the adoption and effectiveness of virtual healthcare solutions. Understanding and addressing cultural considerations are essential for successful implementation and widespread acceptance of telemedicine. Moreover, Telemedicine has the potential to improve access to healthcare services, particularly for individuals residing in remote areas or facing mobility challenges.
- **T** Technological advancements and data security: The rapid progress in digital technologies, including AI, IoT, and high-speed connectivity, presents new prospects for telehealth. Simultaneously, ensuring robust data security measures and encryption protocols is crucial to safeguard sensitive medical information and establish trust in telemedicine platforms.
- **E** Sustainability: Telemedicine can contribute to reducing carbon emissions by minimizing patient travel to physical healthcare facilities. By promoting remote consultations and reducing the need for transportation, telehealth supports environmental sustainability efforts.
- **L** Legal Responsibility: Legal issues, such as physician liability, telepresscription regulations, and teleconsultation guidelines, can impact the adoption and provision of telemedicine services. Establishing clear legal frameworks and addressing liability concerns are essential for the widespread adoption of telehealth practices.

Business Model Analysis examines the products and services offered by the eight selected telehealth startups. This analysis allows us to gain insights into the market positioning and degree of differentiation among these companies. We have observed that some startups, like Transcarent, are still in the early stages of their market positioning due to their recent establishment, these assumptions are based on its recent establishment, specifically in 2019, and the successful completion of the Series C funding round. On the other hand, there are other startups that we consider to have a lower level of differentiation. However, there are also highly innovative and strong startups that exhibit both high differentiation and market positioning. For example, Doctolib, which has been operating since 2013, has successfully established a solid and unprecedented business presence in Europe. Similarly, K Health has created a strong market position in the United States.

This analysis has the goal to focus on business model of the telemedicine startups. In this case, we identified all B2C or mixed B2C/B2B models of the startups analyzed. One notable example of a mixed business model is Transcarent, which caters to both patients and healthcare providers. Transcarent serves as a platform for patients to access affordable healthcare services while also offering software and tools for healthcare providers and medical facilities to enhance their telehealth capabilities. This blended approach allows Transcarent to provide a comprehensive telehealth solution, connecting patients with suitable providers while simultaneously equipping healthcare professionals with the necessary technology. Through my thorough examination, I have observed that the telehealth sector predominantly revolves around B2C or mixed B2C/B2B business models, showcasing the significance of direct consumer engagement in this industry.

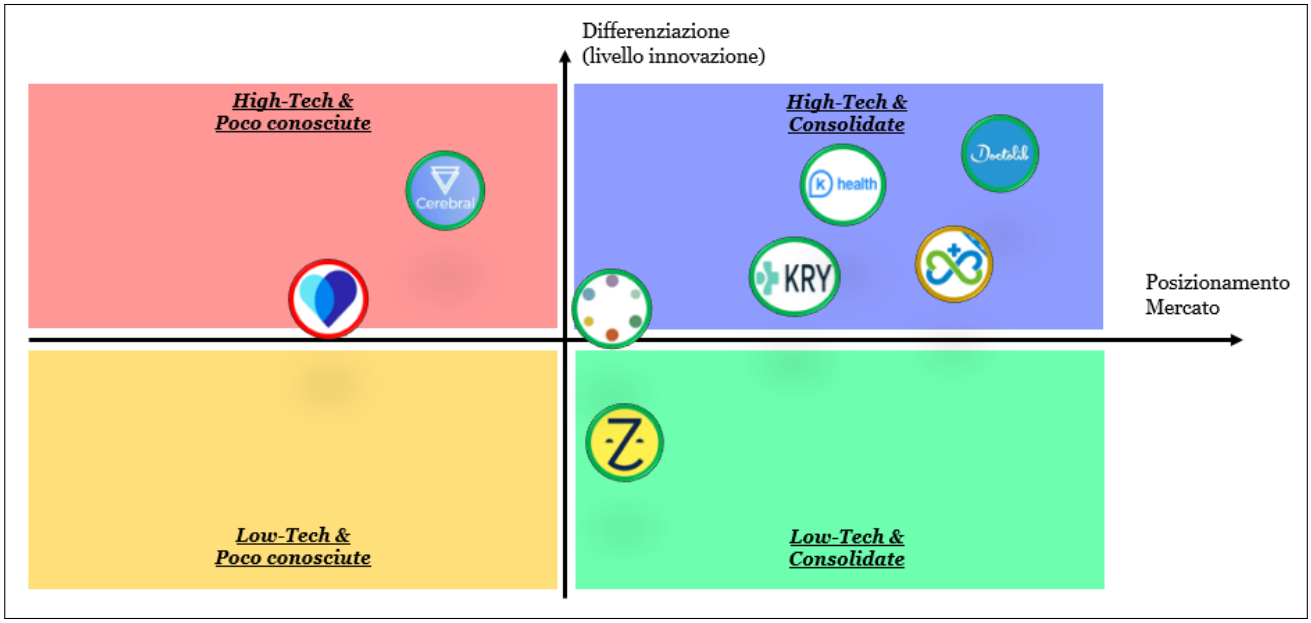

Figure 3: Business model analysis based on 8 Telehealth startup

Startup Lifecycle Analysis took into account the different funding series and the number of years since each company's establishment. This analysis provides valuable insights into the maturity and growth trajectories of the selected telehealth startups.

Among them, Doctolib and WeDoctor stand out as prominent and well-established players in the industry. With several years of experience and a solid business foundation, these companies have achieved a high level of market positioning and differentiation. The success and long-term presence of these companies in the telehealth sector showcase their adeptness in overcoming challenges, sustaining growth, and attracting new investments from various stakeholders.

On the other end of the spectrum, we have startups like Transcarent and Cerebral, which entered the market more recently. These companies are still in the early stages of their lifecycle, with opportunities for rapid growth and development ahead. While they may currently have lower levels of market positioning and differentiation, their innovative approaches and unique value propositions hold promise for future success.

By examining the varying stages of the startup lifecycle, we gain a comprehensive understanding of the different trajectories and potential outcomes for telehealth startups. This analysis allows us to compare their strategies, identify growth opportunities, and assess their overall viability in the evolving digital healthcare landscape.

Quantitative Algorithms Analysis: To further evaluate the selected telehealth startups, we employ two quantitative algorithms, namely the Startup Success Score (SSS) and the Startup Maturity Score (SMS). These algorithms assess and compare the startups based on various criteria, providing quantitative insights into their maturity and success levels. Both indicators range from 0 to 1, with higher scores indicating stronger performance.

The SSS algorithm takes into account country-specific funding, job growth rates, funding types, employee count, total funding received compared to competitors, and startup valuation. It provides an overall as-

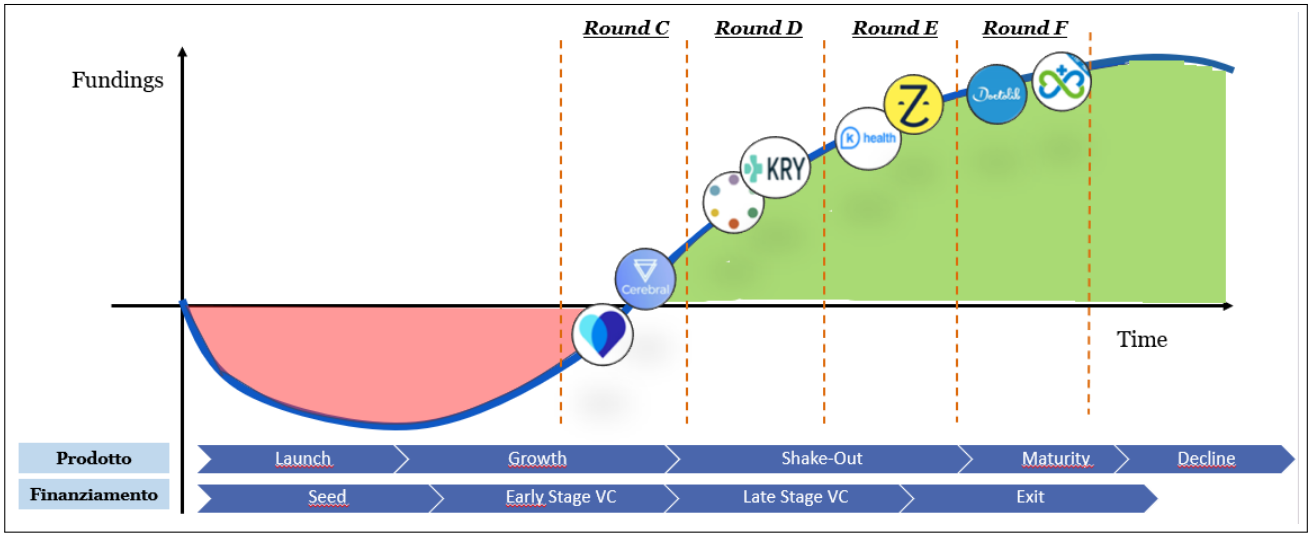

Figure 4: Startup LifeCycle analysis based on 8 Telehealth startup

sessment of each startup's success in terms of financial performance, market traction, and growth potential.

There are some assumption about this algorithms, in particular can show some example:

- USA startups received more fundings than Europe startups. This assumptions can be confirmed by this anlysis of Chrunchbase website[§]. Despite the gap narrowing over the past decade, there are still notable differences in Series A funding between Europe and the USA. Here's an example of the results for startups at the Series A stage: In 2021, the median Series A funding in Europe was $8.5 million, with an average of $14.2 million, based on data from Crunchbase. On the other hand, in the USA, the median Series A funding reached $13 million, with an average of $22.7 million. These figures highlight the disparity in investment levels between the two regions. Although Europe has made progress in bridging the gap, the USA still maintains a higher median and average Series A funding, indicating the presence of a more robust investment ecosystem for startups in the telehealth sector.

- I assigned higher scores to startups that have successfully reached Series E or F funding rounds. This is because reaching these later-stage funding rounds demonstrates a significant ability to attract substantial capital and indicates the startup's resilience and growth potential. Startups that have secured Series E or F funding have likely demonstrated sustained success, market traction, and the confidence of investors, as these rounds typically involve larger investments and more established funding partners. By associating higher scores with startups at these advanced funding stages, I aimed to highlight their remarkable capacity to attract capital, a key indicator of their overall strength and potential for long-term success in the telehealth sector.

[§]https://news.crunchbase.com/venture/european-venture-us-comparison-investment-round-size/

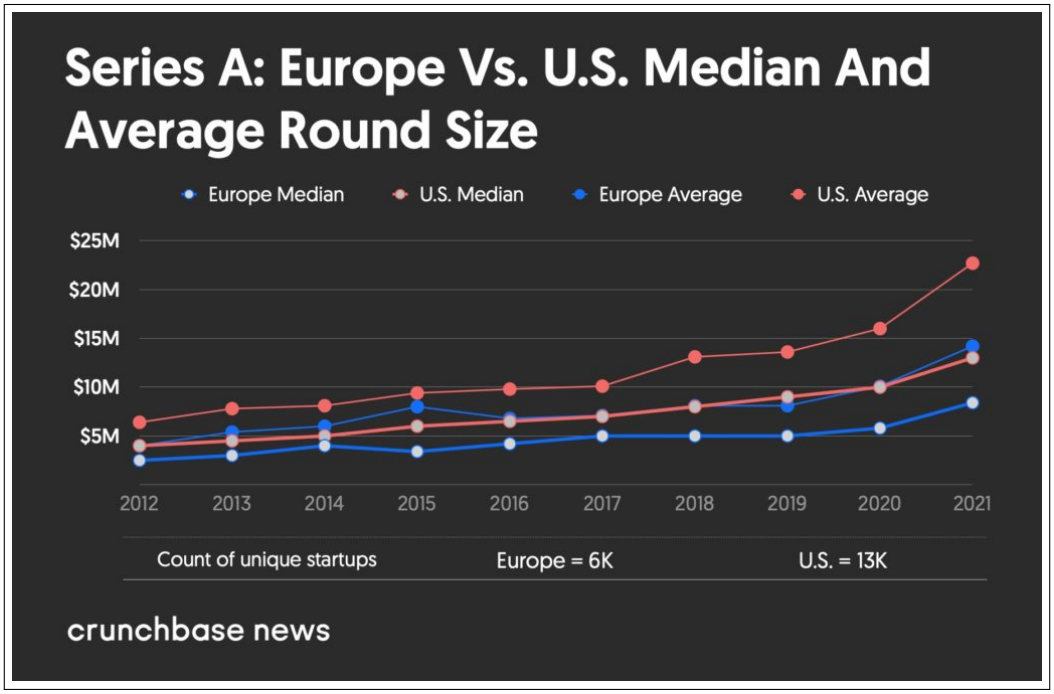

Figure 5: Comparison from different startup's growth from USA and EU

The SMS algorithm evaluates startups based on their age, number of funding rounds, and the weightage assigned to the type of funding round. Older startups with a higher number of funding rounds relative to their age receive a positive contribution to their maturity score. The weightage assigned to specific funding rounds, such as Series F, also factors into the maturity assessment.

Based on the application of these algorithms, we obtained the following rankings for the selected telehealth startups:

Startup Success Score (SSS):

1. Cerebral: 1.00
2. Doctolib: 0.92
3. WeDoctor: 0.67

Startup Maturity Score (SMS):

1. Carbon Health: 1.00
2. Doctolib: 0.98
3. K Health: 0.96

These rankings provide valuable insights into the relative performance of the startups based on their success and maturity levels. It is important to note that these scores are based on the specific criteria and algorithms employed, offering a quantitative perspective on their overall standing within the telehealth landscape. These analyses will be discussed in detail in subsequent sections, providing a comprehensive overview of the selected telehealth startup and their strategic outlook.

2.3 Analysis of a successful startup: Doctolib

The analyses conducted using the SSS (Startup Success Score) and SMS (Startup Maturity Score) indicators have identified Doctolib as a clear example of success in the digital healthcare sector. Therefore, in the next chapter, we will focus our attention on this company, analyzing the strengths and weaknesses that have contributed to its remarkable success.

Doctolib is a successful startup founded in France in 2013, operating in the field of digital healthcare. The company has developed an innovative online platform that connects

patients with medical professionals, simplifying the appointment booking process and optimizing clinic management. Doctolib's solution has quickly gained popularity due to its effectiveness and ability to meet market needs. The company has continued to grow significantly over the years. Among the strengths that have contributed to Doctolib's success, the following stand out:

- Efficient appointment booking: Doctolib has revolutionized the way patients book medical appointments through its online platform, reducing waiting times and improving access to healthcare.
- Extensive network of professionals: The Doctolib platform has expanded nationally, collaborating with thousands of medical professionals and healthcare centers, offering patients a wide range of care options.
- Integrated solutions: In addition to online booking, Doctolib offers a range of integrated solutions for medical professionals, including appointment management, digital medical records, and telemedicine. These features improve the efficiency and quality of care provided.
- Sustained growth: Thanks to its effective expansion strategy and adoption of new technologies, Doctolib has achieved consistent growth over time, consolidating its position in the digital healthcare market.
- Positive social impact: The digital transformation introduced by Doctolib has had a positive social impact, improving access to healthcare and simplifying the lives of patients, offering them greater convenience and flexibility.

Furthermore, several analyses have been conducted on Doctolib, including Porter's Five Forces Analysis, SWOT Analysis, Canvas Model Analysis, and Social Media Analysis. Among these, the three most significant analyses are the SWOT Analysis, Business Canvas Model and Social Media Analysis.

SWOT Analysis assesses Doctolib's internal strengths and weaknesses, as well as external opportunities and threats. It provides valuable insights into the company's current position and its ability to navigate the competitive landscape. In particular, we can summarize the analysis in these points:

- **Strengths:** Established platform: Doctolib has a well-established online booking platform that offers an intuitive user experience and simplifies the process of scheduling medical appointments. Extensive network of doctors and specialists: The company has built a large network of doctors and specialists who provide their services on the platform, offering a diverse range of healthcare professionals for patients. In addtion also, wide geographical coverage, Seamless integration solutions with appointment management and Good reputation and trust.
- **Weaknesses:** Dependency on internet connectivity: Being an online telemedicine platform, Doctolib relies on reliable internet connectivity to ensure continuous service availability. Technical issues or network interruptions can impact accessibility and the user experience. Linguistic and cultural limitations: Doctolib may face challenges related to linguistic and cultural differences in providing services internationally. The company may need to address translation issues and adapt solutions to the specific needs of different communities and cultures.
- **Opportunity:** Growing market: The telemedicine sector is experiencing rapid growth, offering ample opportunities for Doctolib to expand and penetrate the market. Technological innovation: Emerging technologies and trends in the

industry, such as artificial intelligence and the Internet of Things (IoT), provide opportunities for Doctolib to further innovate and enhance its services.

- **Threats:** Regulation and compliance: Regulations and laws related to telemedicine can be complex and ever-changing. Data security: Secure management of patients' health data is a critical priority for Doctolib. The threat of cybersecurity breaches or unauthorized access could compromise the company's reputation and user trust.

Business Canvas Model

In this section, there is a briefly summary of a Business Model Canvas for Doctolib:

- Key Partnerships: Doctolib establishes partnerships with healthcare providers such as doctors, clinics, and hospitals to offer their services on the platform. They also collaborate with technology partners to enhance their platform's functionality.

- Key Activities: Doctolib's main activities include operating an online platform that enables patients to book appointments with healthcare providers, managing the scheduling and calendar systems, and facilitating communication between patients and providers.

- Key Resources: The key resources for Doctolib include its technology infrastructure, software platforms, a large network of healthcare providers, and a strong brand presence in the healthcare industry.

- Value Proposition: Doctolib offers convenience to patients by providing a user-friendly platform for easy appointment scheduling, reducing waiting times, and enabling telemedicine consultations. For healthcare providers, Doctolib helps streamline their appointment management, increase patient reach, and improve overall efficiency.

- Customer Segments: Doctolib targets both patients who require healthcare services and healthcare providers seeking a comprehensive appointment management solution.

- Customer Relationships: Doctolib maintains customer relationships through its platform's user experience, personalized communication, and customer support channels. They also facilitate interactions between patients and healthcare providers.

- Channels: Doctolib operates primarily through its online platform and mobile application, allowing patients to access their services conveniently. They also utilize various marketing and promotional channels to reach both patients and healthcare providers.

- Revenue Streams: Doctolib generates revenue through a commission-based model, where healthcare providers pay a fee for each appointment booked through the platform. They may also offer premium services and subscriptions to generate additional revenue.

- Cost Structure: The main costs for Doctolib include technology infrastructure maintenance, platform development, marketing and advertising, customer support, and operational expenses.

This summary provides a brief overview of the various components of a Business Model Canvas for Doctolib, highlighting the key aspects of their business model.

In addition, the Social Media Analysis plays a vital role in understanding the brand perception and image of a startup. By analyzing the sentiment expressed in user-generated

content, such as comments, reviews, and social media posts, valuable insights can be gained into how the startup is perceived by its target audience. This analysis provides a comprehensive understanding of the overall sentiment towards the brand, allowing the startup to evaluate the effectiveness of their marketing strategies, identify potential areas for improvement, and make informed decisions to enhance their brand image and reputation. By leveraging social media sentiment analysis, startups can actively manage their online presence, build positive brand associations, and foster a strong and favorable perception among their audience.

Social Media Analysis delves into Doctolib's presence and performance across various social media platforms. It involves monitoring and analyzing the company's engagement, reach, sentiment, and overall brand perception on platforms such as Facebook, Twitter, Instagram, and LinkedIn. By examining how Doctolib is perceived and received by its target audience on social media, this analysis provides insights into the effectiveness of the company's marketing and communication strategies. Positive sentiment, high engagement rates, and a strong online presence can indicate a favorable brand image and customer satisfaction. Conversely, negative sentiment or low engagement may highlight areas for improvement or potential concerns that require attention.

One notable aspect is Doctolib's reputation as a company with excellent employee welfare, which resonates positively on social media platforms. This positive image is evident in the sentiments expressed in social media posts and tweets.

This analysis helps Doctolib evaluate the impact of its social media efforts and make informed decisions to enhance its online presence and strengthen its brand reputation. By conducting these comprehensive analyses, Doctolib gains valuable insights into its internal capabilities, market positioning, and customer perception. Armed with this knowledge, the company can leverage its strengths, address weaknesses, seize opportunities, and mitigate threats, ultimately driving its continued success in the digital healthcare industry.

3 Advantages, Challenges, and Limitations of the Digital Healthcare Sector

The digital healthcare sector brings numerous benefits to the healthcare industry, revolutionizing the way medical services are delivered and improving patient outcomes. However, it also faces several challenges and limitations that need to be addressed for its widespread adoption and success[10].

3.1 Advantages

Improved Access

Digital healthcare expands access to medical services, especially in remote or underserved areas, by enabling virtual consultations and remote monitoring. Patients can receive timely care without the need for travel, reducing barriers to access and increasing healthcare reach[13].

Enhanced Efficiency

Digital tools streamline administrative processes, reduce paperwork, and automate tasks, leading to increased efficiency in healthcare delivery. Electronic health records and digital communication systems enable seamless information sharing among healthcare providers, improving care coordination and reducing delays.

Personalized Care

Digital healthcare allows for personalized treatment plans, leveraging data analytics and AI algorithms to tailor interventions based on individual patient needs. By analyzing vast amounts of patient data, healthcare professionals can make data-driven decisions and provide targeted therapies, resulting in improved treatment outcomes.

Patient Empowerment

Patients can actively participate in their healthcare journey through access to personal health records, educational resources, and self-monitoring tools. Digital platforms enable patients to take charge of their health, promoting self-management, prevention, and better adherence to treatment plans[2].

Better Health Outcomes

Digital technologies facilitate real-time data collection and analysis, enabling early detection, timely interventions, and improved patient outcomes. Wearable devices, remote monitoring, and predictive analytics empower healthcare professionals to identify health risks, intervene proactively, and optimize treatment strategies.

3.2 Limitations

Data Security and Privacy

The digital nature of healthcare raises concerns regarding the protection and privacy of patient data, requiring robust security measures and compliance with data protection regulations. Safeguarding sensitive medical information and ensuring secure data transmission are critical to maintaining patient trust and upholding ethical standards.

Technological Barriers

Limited digital literacy, access to internet connectivity, and technological infrastructure can hinder the widespread adoption of digital healthcare, particularly in resource-constrained areas. Bridging the digital divide and providing necessary training and infrastructure are crucial for ensuring equitable access to digital healthcare services.

Reliance on Technology

Overreliance on technology may lead to potential errors, system failures, or dependency on electronic systems, which can impact the delivery of healthcare services. Backup plans, contingency measures, and continuous technical support are necessary to mitigate risks and ensure continuity of care.

Ethical Considerations

Ethical dilemmas may arise concerning the collection, use, and ownership of patient data, as well as the appropriate use of AI algorithms and automation in medical decision-making. Transparent governance frameworks, ethical guidelines, and informed consent procedures are essential for maintaining ethical standards and preserving patient autonomy[6].

Health Inequalities

The digital divide can exacerbate existing health inequalities, as certain populations may face barriers in accessing and utilizing digital healthcare, widening the healthcare disparities gap. Addressing disparities in digital literacy, affordability, and accessibility is crucial to ensure equitable healthcare delivery for all.

In conclusion, the digital healthcare sector offers immense advantages in terms of improved access, enhanced efficiency, personalized care, patient empowerment, and better health outcomes. However, challenges related to data security, technological barriers, overreliance on technology, ethical considerations, and health inequalities must be carefully addressed to maximize the potential of digital healthcare and ensure its benefits are accessible to all.

4 Conclusions

In conclusion, the Digital Healthcare sector has witnessed significant growth and transformation, revolutionizing healthcare delivery through the use of digital technologies. Improved access to medical services, enhanced efficiency, personalized care, patient empowerment, and better health outcomes are among the advantages brought about by digital healthcare[4]

However, the sector also faces various challenges and limitations. Data security and privacy concerns, technological barriers, reliance on technology, ethical considerations, and health inequalities are some of the key constraints to be addressed. These challenges require careful attention and proactive measures to ensure the responsible and effective implementation of digital healthcare solutions.

Despite the challenges, the Digital Healthcare sector presents immense opportunities for innovation, investment, and positive impact on healthcare. The sector's substantial investments, growing utilization of digital health technology, and promising market projections demonstrate its potential for transformative change[8].

To fully leverage the opportunities and address the challenges, it is essential to understand the dynamics of the sector. A comprehensive analysis of the literature using an industry-based classification framework can help researchers, practitioners, and policymakers navigate the vast landscape of Digital Healthcare more effectively. This classification approach allows for targeted research, identification of research gaps, and the development of focused agendas to drive innovation and advancements in healthcare delivery.

Moreover, this project's contribution lies in the in-depth analysis of the HealthTech Unicorn startup market within the digital healthcare sector. Through data extraction, technical analysis, strategic comparison, and business model analysis, the project aims to identify startups with the highest potential for success. The results of this analysis will provide valuable insights into industry dynamics and serve as a foundation for informed decision-making[16].

In conclusion, the Digital Healthcare sector holds great promise and presents both challenges and opportunities. By addressing the limitations and leveraging the advantages, the sector can continue to revolutionize healthcare, improve patient outcomes, and drive progress in the digital era of healthcare delivery.

5 Additional Materials

There are two main additional documents link to this article: first script in Python used for scraping and the second script used to model algoritms in Python.

Script to scrape data of 140 startups: Scraping.py

```
import requests
from bs4 import BeautifulSoup
import pandas as pd
```

```
# Send a GET request to the URL
url = 'https://www.holoniq.com/healthtech-unicorns'
response = requests.get(url)

# Parse the HTML content using BeautifulSoup
soup = BeautifulSoup(response.content, 'html.parser')

# Find the table element with class 'grid-table'
table = soup.find('div', class_='grid-table')

# Find all rows in the table except the header row
rows = table.find_all('div', class_='table-row')[1:]

# Create empty lists to store the data
company = []
country = []
industry = []
last_round = []
type_ = []
valuation = []

# Loop through each row and extract the data
for row in rows:
    cols = row.find_all('div', class_='table-col')
    company.append(cols[0].find('a').text)
    country.append(cols[1].text)
    industry.append(cols[2].text)
    last_round.append(cols[3].text)
    type_.append(cols[4].text)
    valuation.append(cols[5].text)

# Create a DataFrame to store the data
df = pd.DataFrame({
    'company': company,
    'country': country,
    'industry': industry,
    'last_round': last_round,
    'type': type_,
    'valuation': valuation
})

# Save the DataFrame as an Excel file
df.to_excel('healthtech_unicorns.xlsx', index=False)
```

Script to create two functions for the two algorithms

```
# IMPORT
import pandas as pd
import numpy as np

#MAIN
# Creazione del dataframe con le informazioni delle startup
data = {
    'company': ['Doctolib', 'K Health', 'Zocdoc', 'WeDoctor',
      'Carbon Health', 'Cerebral', 'Transcarent', 'KRY'],
    'founding_year': [2013, 2016, 2007, 2010, 2015, 2019, 2018,
      2014],
    'country': ['France', 'United States', 'United States',
      'China', 'United States', 'United States', 'United States',
      'Sweden'],
    'industry': ['Bookings & Referalls', 'Telehealth', 'Bookings &
      Referalls', 'Telehealth', 'Telehealth', 'Mental Health',
      'Bookings & Referalls', 'Telehealth'],
    'macro-industry': ['Telemedicine', 'Telemedicine',
      'Telemedicine', 'Telemedicine', 'Telemedicine',
      'Telemedicine', 'Telemedicine', 'Telemedicine'],
    'last_round': ['Mar 2022', 'Jan 2021', 'Feb 2021', 'Jan 2021',
      'Jul 2021', 'Dec 2021', 'Nov 2022', 'Apr 2021'],
    'Fundings_Last_Round': ['$549M', '$132M', '$150M', '$411M',
      '$350M', '$300M', '$200M', '$319M'],
    'Numero Round Finanziamento': [9, 8, 10, 8, 10, 3, 3, 9],
    'Type Round': ['Series F', 'Series E', 'Series E', 'Series F',
      'Series D', 'Series C', 'Series C', 'Series D'],
    'valuation': ['$6.4B', '$1.5B', '$1.8B', '$7.0B', '$3.0B',
      '$4.8B', '$1.6B', '$2.0B'],
    'Numero investitori': [13, 23, 19, 16, 46, 15, 16, 11],
    'Numbero di Acquisizioni effettuate': [4, 1, 0, 1, 4, 0, 2, 1],
    'TOTAL FUNDINGS': ['$815M', '$271M', '$375.9M', '$1,400.00M',
      '$622.18M', '$462.65M', '$298M', '$729M'],
    'Number Emloyee': ['1000-5000', '251-500', '501-1000',
      '1,000-5,000', '501-1000', '1,000-5,000', '251-500',
      '501-1000'],
    'Job offer active Maggio 2022': [19, 41, 32, 4, 251, 98, 21,
      34],
    'Job offer active Novemebre 2022': [11, 20, 30, 6, 421, 115, 9,
      46],
    'Job offer active Maggio 2023': [198, 24, 37, 10, 354, 182, 2,
      96]
}

df = pd.DataFrame(data)

# varibiabili globali:
```

```
# Define the weights for funding types
funding_type_weights = {'Pre-seed': 0.3, 'Series A': 0.4, 'Series
    B': 0.5, 'Series C': 0.6, 'Series D': 0.7, 'Series E': 0.8,
    'Series F': 0.9}

# Define the weights for employee numbers
score_number_dipendenti = {'251-500': 0.3, '501-1000': 0.55,
    '1000-5000': 0.8}

#FUNCTIONS

def data_manipulation(df):
    # Rimozione del simbolo "$" e "M" dalla colonna "TOTAL FUNDINGS"
    df['TOTAL_FUNDINGS'] = df['TOTAL_FUNDINGS'].str.replace('$',
        '', regex=False).str.replace('M', '',
        regex=False).str.replace(',', '', regex=False)

    # Rimozione del simbolo "$" e "B" dalla colonna "valuation"
    df['valuation'] = df['valuation'].str.replace('$', '',
        regex=False).str.replace('B', '', regex=False)

    # Rimozione del simbolo "$" e "M" dalla colonna
        "Fundings_Last_Round"
    df['Fundings_Last_Round'] =
        df['Fundings_Last_Round'].str.replace('$', '',
        regex=False).str.replace('M', '', regex=False)

    # Conversione delle colonne in numeri interi
    df['TOTAL_FUNDINGS'] = df['TOTAL_
        FUNDINGS'].astype(float).astype(int)
    df['valuation'] = df['valuation'].astype(float).astype(int)
    df['Fundings_Last_Round'] =
        df['Fundings_Last_Round'].astype(float).astype(int)

    # Rimozione delle virgole e conversione in numeri interi per la
        colonna "Number Emloyee"
    df['Number_Emloyee'] = df['Number_Emloyee'].str.replace(',',
        '', regex=False).astype(str)
    df['Number_Emloyee'] = df['Number_Emloyee'].apply(lambda x:
        int(x.split('-')[1]) - int(x.split('-')[0]))
    return df


def success_score(df):
    # Calculate the success score for each startup
    success_score = (
        ((df['country'].map({'United_States': 0.8, 'China': 0.75,
```

```
            'France': 0.70, 'Sweden': 0.70}).fillna(0.6)) +
        ((df['Job offer active Maggio 2023'] - df['Job offer active
            Maggio 2022']) / df['Job offer active Maggio
            2023']).fillna(0)) +
        (df['Type Round'].map(funding_type_weights)).fillna(0) +
        (df['Number
            Emloyee'].map(score_number_dipendenti)).fillna(0) +
        (df['TOTAL FUNDINGS'] - df['TOTAL FUNDINGS'].min()) /
            (df['TOTAL FUNDINGS'].max() - df['TOTAL
            FUNDINGS'].min()) +
        ((df['valuation'] - df['TOTAL FUNDINGS']) /
            df['valuation']).fillna(0)
    ) / 6

    # Add the success score to the DataFrame
    df['success_score'] = success_score

    # Normalize the values between 0 and 1
    df['success_score'] = (df['success_score'] -
        df['success_score'].min()) / (df['success_score'].max() -
        df['success_score'].min())

    # Sort the DataFrame by success score in descending order
    df = df.sort_values(by='success_score', ascending=False)

    # Save the DataFrame to an Excel file
    df.to_excel('startup_success_scores.xlsx', index=False)

    # Display the DataFrame
    print(df)

def maturity_score(df):
    # Calcola l'anno corrente come punto di riferimento per
        calcolare eta delle startup
    current_year = pd.to_datetime('today').year

    # Calcola eta delle startup in anni
    df['startup_age'] = current_year - df['founding_year']

    # Calcola lo score eta basato sull'andamento logaritmico
    df['age_score'] = np.log(df['startup_age'] + 1)
    max_age_score = df['age_score'].max()
    df['age_score'] = df['age_score'] / max_age_score

    # Calcola lo score basato sulla proporzione tra il numero di
        finanziamenti e eta della startup
    df['funding_ratio'] = df['Numero Round Finanziamento'] /
```

```
        df['startup_age']
    max_funding_ratio = df['funding_ratio'].max()
    df['funding_score'] = df['funding_ratio'] / max_funding_ratio

    df['type_round_sys'] =(df['Type_
        Round'].map(funding_type_weights)).fillna(0)
    # Calcola lo score complessivo di maturita
    df['maturity_score'] = (df['age_score'] + df['funding_score'] +
        df['type_round_sys'] ) / 3

    # Normalizza lo score tra 0 e 1
    df['maturity_score'] = (df['maturity_score'] -
        df['maturity_score'].min()) / (df['maturity_score'].max() -
        df['maturity_score'].min())
    # Sort the DataFrame by success score in descending order
    df = df.sort_values(by='maturity_score', ascending=False)

    # Save the DataFrame to an Excel file
    df.to_excel('startup_maturity_scores.xlsx', index=False)

    # Display the DataFrame
    print(df)


# Call functions
dfclean=data_manipulation(df)
success_score(dfclean)
print("-"*50)
maturity_score(dfclean)
```

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