

Have we lost the Cyber War?

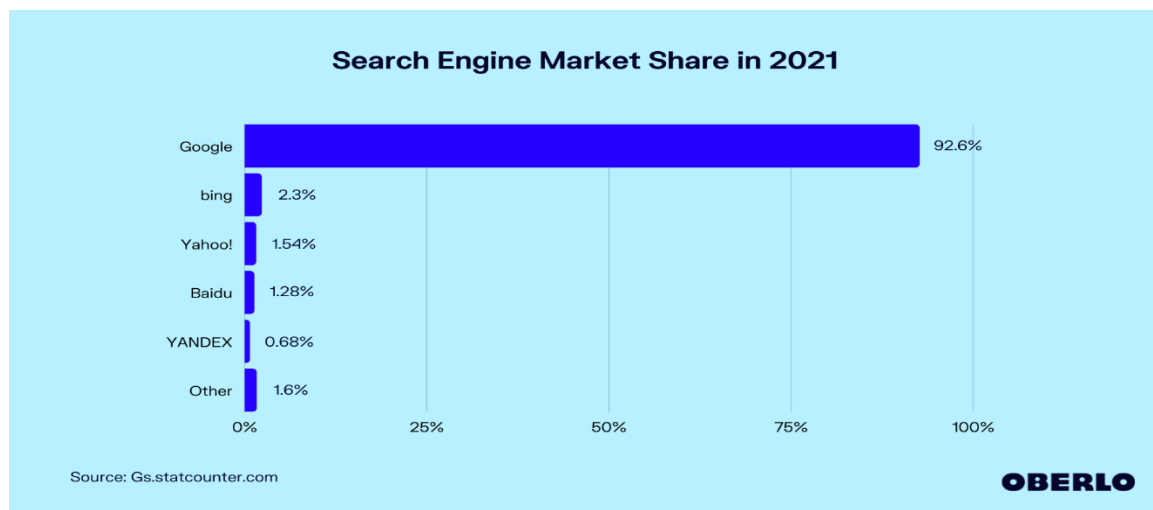
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Introduction. -

Digitalized Information is the core element that is driving the digital society. Information is key on how value and redistribution of power is handled in the digital society. In the connected world Information gains power by permanent storage and wide distribution. Digital information is intangible but once its recorded, it can exist for ever (Park-2017).

Our main source of information is “Google” through its search engine, Google has become essential in our lives. It’s the most popular search engine controlling more than 90% of the international market.



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About the origins of Google as a company we can say that it was founded in 1998 by Larry Page and Sergey Brin (both where PHD students in Stanford at the time). Google was reorganized as a wholly-owned subsidiary of Alphabet Inc. Google is Alphabet's largest subsidiary and is a holding company for Alphabets Internet properties and Interest. (Vise- 2007).

Google is one of the “Big Five” companies in the information technology industry with Amazon, Apple, Meta (Facebook) and Microsoft. The Type of products and services Google offers are: Internet-related, which include online advertising technologies, a search engine, cloud computing, software, and hardware.

Google is a corporation, we get our information from a corporation, there are no clear rules that determine how this information is processed and given to the final users “US”. If we speak about control of information, we can argue that we are in a “Cyber War” in a battlefield where Information is power.

Online we are citizens of a global world governed by the one that possess the power of Information. As citizens of a global world, we have lost control over information. In this sense we can argue that we are in a “Cyber War” for the control of this information.

The US Justice Department argues that not only advertisers but also regular users are harmed by Google's Monopoly as the unchallenged gateway to the internet. It also states “American consumers are forced to accept Google's policies, privacy practices, and use of personal data; and new companies with innovative business models cannot emerge from Google's long shadow.” (*Economic Times- 2020*)

We will concentrate for the purpose of this paper only on Google's Search engine. “The strength of a search engine like google comes from the relevance of the search results and other information it serves its users”. (*Persily 2017, 74*)

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Although this technology is convenient the power it holds should ring alarms, not only economic power but political as well. This is a threat to a well-functioning democracy. (*Fukuyama, Richman and Goel- 2020, 11*)

Research Questions. –

The main research question of the present paper is: **Have we really lost the cyber war in the control of our information?** In an attempt to try to answer this question this analysis has also sub questions like:

- Is it Possible to take the Monopoly away from the main search engine Google?
- Has losing the control of information made us loose the Cyber War? or have we only lost the biggest battle?
- Is it even possible to compete with Google?
- Can the solution be the creation of a private or maybe a national search engine?
- Can having a National Search Engine be seen as a priority of National Security?
- Can we make a more efficient search engine?
- Can we build tools inside google with our own algorithms?

All these questions are present when we are analyzing the present subject and we will try to answer them but it's important to determine that this is only a seminar paper and not a thesis, and perhaps in order to answer these questions a deeper profound analysis is necessary, so again this paper is only an attempt to try to answer these questions.

Problem Space

Over the past decade the “Big Five” have revolutionized the internet economy and affected the daily lives of billions of people worldwide. Google operates a search

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engine that processes over 3.5 billion searches a day (Google Search), it runs the biggest online video platform (YouTube) also licenses the world's most popular mobile operating system (Android) and is the largest seller of online advertising (Freeman-2019).

The “Cyber war” this paper studies are the war over control of information in this case, information that Google's search engine offers us. So, our problem space is the study of google as a search engine and how this search engine is controlling information. We consider in this study the power Google has to not only choose the information it gives us but to blacklist and censor the internet.

In essence this analysis will only study Google as a search engine that has the Monopoly of our search results. It's not the intention to analysis other aspects of google as a company like privacy violations among other, it is also not the intention of this study to determine is Google is or not a true Monopoly and inside this category if it's a good or bad Monopoly. The study is considering Google as a Monopoly of our access to information through its search engine considering it's the most popular search engine in use, as we mentioned before controlling more that 90% of the market.

Google's Search Engine, Other private and National Search engines. -

Before going into Google's search engine, we need to start by explaining what a search engine is, a search engine is a search tool users have to search for information on the web. The search can be done by keywords, the search engine will pop up results containing multiple links to websites, related to the keyword. In general search engines follow basic steps to accomplish their objective:

Crawling. - They use web crawlers that are small programs, following links from one page to another and collecting their data. This process is the process of discovering new web pages.

Indexing. – Each time a web crawler finds new information or a new webpage, it evaluates and processes them. In the processing the content is validated and stored in the search engine database. The webpages that open up with a keyword are the ones already stored and indexed in the search engine database.

Ranking (Results). - This action includes picking the best results and showing them as such on the result page.

Speaking about search engine development and evolution we can say that Google rose to prominence around the year 2000, achieving better results for many searches with its algorithm called “Page Rank”, this interactive algorithm ranks pages according to their number and Page Rank of other web sites and pages that link to it, on the idea that a good page will be linked to other more. Google also maintained a minimalistic interface to its search engine in contrast many of its competitors. (Grimmelmann, 2007).

The last step Ranking and results is the step in which search engines really differentiate themselves: by using varied algorithms to summarize and organize the vast seas of available content. At one time, web search engines simply scanned the text of web pages to determine which topics the pages discussed. They then augmented this technique by analyzing additional information about pages (called “metadata”), such as their age, the number of links they contain, or the keywords used by their authors to describe them. More recently, powerful link-structure techniques involving study of how web pages’ link to each other has become the dominant web search paradigm (Grimmelmann, 2007).

Google as the most popular search engine has its own database, where it processes and looks through for information related to the keyword.

In Google’s own words the last step of their search engine: “Serving search results” they referring to this last step state the following: *“When a user searches on Google, Google tries to determine the highest quality results. The “best” results have many factors, including things such as the user’s location, language, device*

(desktop or phone), and previous queries. For example, searching for "bicycle repair shops" would show different answers to a user in Paris than it would to a user in Hong Kong. Google doesn't accept payment to rank pages higher, and ranking is done algorithmically." (Developers Google-accessed 2022)

Other private search engines, that were providing search engine services around the year 2000 when google started to become dominant in the market where:

- **Yahoo** that was providing search services based on "Inktomi's" search engine company that it acquired around 2002. Yahoo switched to Google's search engine until 2004, when it launched its own search engine based on the combined technologies of its acquisitions.
- **Overture** owned "All the web" and "AltaVista" in 2003.
- **Microsoft** first launched MSM search in 1998 using search results from "Inktomi". For a short time in 1999, MSM search used results from Alta Vista. In 2004 it began a transition to its own search technology powered by its own web crawler called "msmbot". **Microsoft** rebranded its search engine **BING** that was launched in 2009. Microsoft and Yahoo made a deal in which yahoo search would be powered by Microsoft Bing Technology.
- Until 2019 search engine crawlers include: **Google, Petal, Sogou, Baidu, Bing, Gigablast, Mojeek, DuckDuckGo** and **Yandex**.

In the following table we can see some example of Search Engines mergers and acquisitions, in which that particular author divides search history in 3 periods, that is not the purpose of the present study to analyze therefore we will not go into further detail and simple mention the graphic as an example to facilitate understanding and to prove a point that private companies over time have tries to compete with Google.

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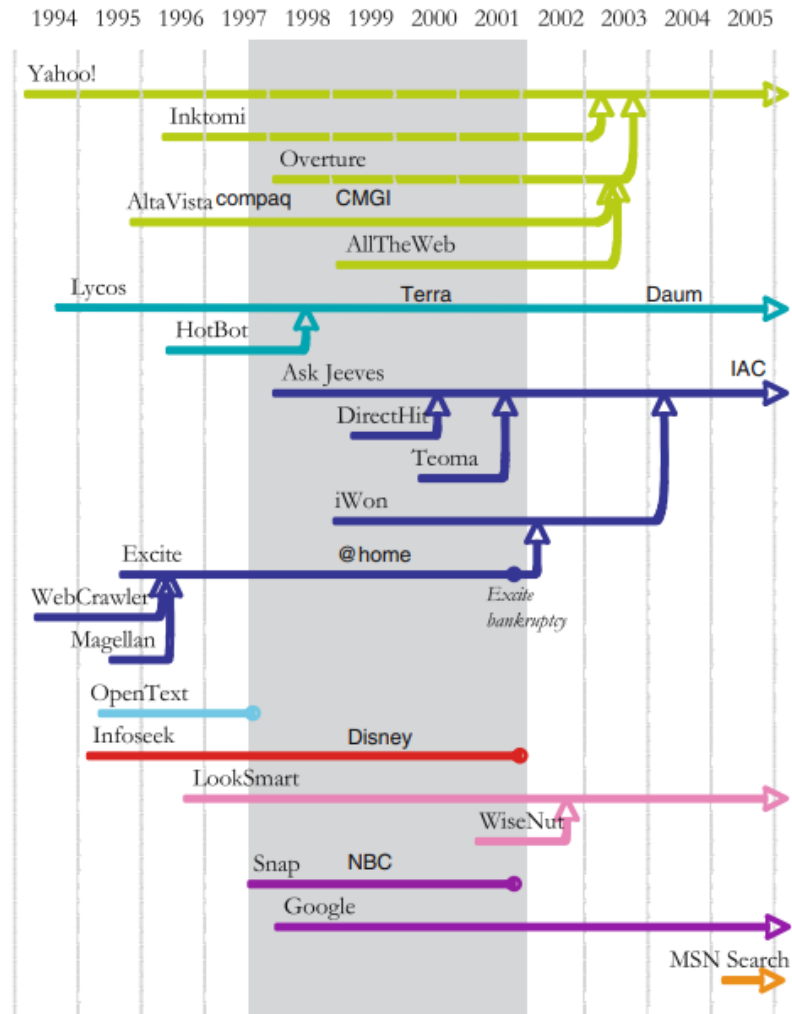


Fig. 11.1 Search engine mergers and acquisitions in the three periods of search history. Data from company Websites and press reports

(Couvering, 2008)

National Search Engines. –

Some countries are starting to have concerns about Google's monopoly, some say it's not only a matter of privacy and control but a matter of National Security (*ABC Science- 2021*).

State-Sponsored search engines have received virtually not much scholar attention, the majority of web search studies focuses on private search engine

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giants like Google and Yahoo. Neglecting important international players like China's Baidu and Russia Yandex among other examples.

It is a fact that States also want to control information. Regarding this we will explain some cases.

CHINA. –

When in 2010 Google made the announcement that it would stop censoring search results in China. In response China claimed “internet sovereignty” over its territory. It created the State Internet Information Office as a centralized authority to coordinate internet regulation in China. First a State Search engine GOSO was unveiled. Other state sponsored search engines where PANGUSO (a joint venture between Xinhua News Agency and China Mobile both state owned companies) and CCT Search. GOSO was renamed JIKE in 2011 and acquired the form of a joint venture. JIKE functioned as a stand-alone search engine. (*Jiang and Okamoto- 2014*)

Some Chinese experts sustain that their authorities underestimated the effort it takes to develop a commercially viable search engine. JIKE failed technologically, strategically and managerially. JIKES failure has not put an end to state search experiments in China. JIKES merged with PANGASU, the future of state engines remains highly uncertain but its subject to both politics and competition. (*Jiang- 2014*)

RUSSIA. -

Russian State-Controlled telecoms group “Rostelecom” launched in 2014 an internet search engine named after the SPUTNIK satellite, with a cost of US\$42million. Some argued that it was doomed before it was even yet launched considering it was going to compete in a highly competitive market. The Russian government had mad moves before to control the internet, but a state-backed search engine, had to compete with market leader Yandex with 62 percent of the Russian market. Search engines were a completely different area from the telecoms service business in which Rostelecom was involved. Because of the lack

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of experience, the new project was doomed. At the end the project failed getting users. (Davies-2013, accessed 2021)

OTHER COUNTRIES: -

Building a search engine that competes with google can also cost millions. Cases like **Australia** and in 2005 **France** and **Germany** tried with a search engine named “Quaero” they were going to allocate 450 million euros over 5 years to develop this search engine at the end Germany pulled out of the project considering that by the time the search engine was finished, Google’s search engine would be light years ahead. **Japan** also allocate money to private companies to try to take on Google. (ABC Science- 2021).

Google as an information Monopoly. -

Why is Google being considered as an information Monopoly? We can start to try to answer this question by saying that:

Google benefited from the commodification of Internet in order to consolidate its dominance and become one of the largest and most powerful multinationals on earth. It uses its market power to eliminate any potential or real competition; it uses abuses loopholes in the regulatory framework preventing the authorities to limit its hold over digital communication; it takes advantages of financial globalization to increase profits and avoid taxes; it collects and exploits personal data of Internet users. Google is not naïve how it tries to portray itself, it has real political influence. (Smyrnaio-2019)

The ultimate determinant of market power is elasticity of demand. Alphabet (formerly Google), the world most valuable company in 2016, holds a Monopoly on internet search that is driven by demand elasticity. Every Monopoly strives to

maintain 3 factors: Elasticity of demand, low number of firms in the market, and minimal competition between firms in the market. Many Monopolies have begun when an innovative idea begins to grow fast and competitors cannot access the source of the firm's competitive advantage. In the case of Alphabet, the inaccessible source of its competitive advantage is the property algorithm for the Google Search engine. Some argue that Alphabet is not an evil monopoly, because companies have found ways to compete with Google and they can still continue to compete. (Moyer-2015).

A USA federal district court dismissed allegations that Google was monopolizing the market in online searches on the grounds that Google does not charge customers to use its search engine. Several commentators have echoed the general line of reasoning behind this decision and questioned whether the provision of free services can result in the type of consumer harm that antitrust law is intended to remedy. Some of these commentators have argued that zero-price transactions are not in fact "free" to consumers, and that consumers ultimately "pay" for putatively "free" goods and services with both their attention and personal data. According to this line of argument, many of these consumers may be overpaying. (Katz-2012).

Manipulation of Search Engine Algorithms, can we change Google's algorithms?

Algorithms can personalize, filter and rank online content, they are starting to play an influential role in everyday life. They can enable content in a rapid and effective way having the potential to improve decision making on a massive scale. Google produces billions of ranked information lists per month. But we shouldn't forget that algorithms are human inventions, so as such can have hidden in them intentions, beliefs and biases that are influencing their design and function. Recent research has also demonstrated that society's growing dependence on ranking algorithms

leaves our psychological heuristics and vulnerabilities susceptible to their influence on a very high scale. Concerns about their power and influence have been expressed by some regulators and users arguing the lack of transparency in the inputs, parameters and processes used by ranking algorithms. (Epstein-2017)

Some studies have presented evidence about the power and robustness of what they call the search engine manipulation effect (SEME), showing the biased search engine rankings and how they can shift the voting preferences of undecided voters by 20% or more, these rankings are masked and people are not aware of them or the manipulation. (Epstein-2017)

Maybe building a search engine is not the solution other possible solutions can be creating tools inside the search engine that give us the information in a more impartial way. But before exploring this option we should ask ourselves:

- Is google manipulating algorithms to its advantage?
- Can other countries and users manipulate and change Google's algorithms?

Search Engines can direct users toward particular websites by listing the website on the first page of a user's search results. They can also direct users away from other websites by hiding them in the last pages of a user's search results. They can hide online content from users. Google has the power to list the website it wants to appear first; this practice is known as "search engine manipulation". Google was subject to an investigation regarding this by the US Federal Trade Commission FTC, the investigation was promoted mostly by the pressure suffered by FT from legal scholars and Google's main competitors mainly Microsoft. (Woan-2013)

Many sustain and have proven that Google changes its algorithms to punish its competitors, they also sustain that Google should publish the inner workings of its search engine, provide unbiased search results, and allow equal opportunity of their prime advertising space. (Moyer-2015)

The Misuse and manipulation of search results is only one of the many critics Google faces, some also critics its compilation of data violating privacy, censorship of search results and content, indexing and presenting false information and propaganda in search results and misuse of search results. Among others that we find are not relevant to the present study but just will be mentioned as a matter of examples: Tax avoidance, use of others intellectual property, Energy consumption of its servers, restraint of trade among others.

To investigate how search engine, manipulate the rankings of search results. Search engines employ different ranking methods in order to display the “best” results first. One of the ranking methods is “PageRank”, where the number of links pointing to the page influences its rank. The “anchor text,” the clickable text of the hypertext link is another part in the ranking method. There are a number of cases where the public challenged Google's ranking, by creating a so-called “Google bomb” – creating links to pages they wanted to be highly ranked for given query. Some users pay for search engine optimization, while others utilize the power of the crowd to influence Google's rankings. (Bar-Ilan-2007)

If we consider algorithms to be manipulated, then its only logic to think that they should be in some cases audited. In the mind of people algorithms like Google's search engine algorithm exist in order to satisfy their users, in this sense it might seem like they are not manipulated. However, although it might be true that a search algorithm that doesn't satisfy its users will probably not continue to be in operation for long, it's important to note that most situations in which algorithms are employed permit the algorithms to satisfy multiple goals simultaneously. There are many ways an algorithm can be manipulated, without necessarily causing direct disadvantages to its users. An example of this is a user visiting Google to get expert health advice on a medical condition or symptom, this user can be equally satisfied by information he finds in WebMD or the centers for disease control and Google health. However, it an algorithm audit it was discovered what appeared to be a series of hard-coded rules placing Google- provided services at the top of the search results.

The majority of scholars that have considered algorithmic manipulation in the past have done so in the perspective of law and regulation. Legal approaches have included the promulgation of regulations about algorithms (as the Aeronautics Board regulated SABRE) and the use of powerful tools of public scrutiny as the subpoena. Yet the public may need to still know something about how algorithms operate even if there is no recourse to legal tools and it is not likely that a crime has been committed. (Sandvig-2014)

So, we can affirm that internet search rankings have a significant impact on consumer choices, most of all because users trust and choose higher-ranked results more than lower-ranked results.

Examples cases of Search Engine Manipulation

Speaking about Biases in search results we have the case of for example **“MyTriggers.com”** an Ohio-based shopping search site accused Google of favoring its own services in search results. (Edelman-2011).

About the background of this case, we have that: My Triggers was a "vertical search" site, which allowed users to compare prices for a specific segment of online content. In an effort to create a greater amount of user traffic to its site, My Triggers began using AdWords in 2005 and developed keyword databases to be used on AdWords. Eventually, My Triggers line of credit with Google reached over \$250,000 per month. In 2008, my Triggers datacenters experienced overheating incidents, causing damage to equipment and forcing my Triggers to move to a new datacenter and lay off some personnel. In March of 2008, Google raised the

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minimum bids for My Triggers' keyword bids. Google brought the instant action, seeking to collect amounts owed to it by My Triggers for advertising. The case was lost by "My Triggers" some argue it was due to the lack of good legal ground. (Goldman- 2011)

Although we agree with the fact that the case could have been won if confronted with other legal arguments it is not the objective of the present analyses to do any type of legal analysis of the example cases we will mention.

Transport tycoon **Sir Brian Souter**, voiced concerns regarding the fairness of Google's PageRank and search results after their web sites disappeared from Google's first-page results.

Background of this case: Sir Brian Souter accused Google of diverting traffic away from his website, he accused Google of stopping links to his site appearing when people search for it. Souter website included biography details, a picture gallery, and regular updates of his activities. One of his representatives stated that the website is neither commercial or used with political purposes. "It's not Google's place to decide which sites we can see and those we can't" he sustained in his statement. He contacted Google over the issue and was informed that changes to their search algorithm was the cause of the disappearing links and advised him on how to improve the sites ranking. (Langshaw, 2011)

The Case of **E-ventures** now called Headline, this company is an online publishing and research firm that reviewed products and services in specific industries. The majority of its revenue derived from "search engine optimization" which is the process of causing websites to be ranked and displayed more prominently in search results, without payment being made to the search engine. Google's main revenues are from "Ad Works" advertising program, through where consumers pay to have their websites ranked and displayed in Google's search results. Search engine Optimization companies focus on how their client's websites can obtain a higher ranking on Google's unpaid search result. E-ventures argued that Google

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had an anti-competitive, economic motivation to eliminate the visibility of e-ventures websites on its search engine results. Google removed E-ventures web sites communicating to them that it had done so because they were considered “Pure Spam”. According to Google’s own definition of “Pure Spam” is when it detects some of the pages are using techniques that are outside Google’s Webmaster Guidelines. The websites removed by Google in this case included corporate websites of e-ventures, in total 365 e-venture websites were removed. Google only relisted them after the legal complaint was presented by E-Ventures. At the end it was decided in this case that the US “First Amendment” protects Google’s actions and precludes all of e-ventures’ claims. (CaseText- 2016)

The first amendment is explained by some authors in Google’s case as the following:

Before the leading sources of information for people were newspapers, guidebooks, encyclopedias. Today, these sources also include search engine results, which people use along with other sources, to learn about news, local institutions, services and products among other things. Then and now the First Amendment in US has protected all these forms of speech from attempts by the government to regulate what and how they present these forms of speech. Google as a search engine is a speaker, sometimes conveying information that the search engine has itself prepared or compiled. Second, they direct users to material created by others, by referencing the titles of Web pages that the search engine judge to be more relevant to the search. All this is in US considered constitutionally protected speech. So, the judgment that Google makes is the same as an editorial judgment, like newspapers choosing what story to run. Even if Google decides to prioritize some information over other this is part of Google’s legitimate exercise of the First amendment (speech). Two federal court decisions have been made in US regarding this:

- **Search King, Inc. Vs. Google Technology, Inc., (2003)** concluded that googles ranking of pages constituted protected opinions entitled to full constitutional protection.
- **Langdon Vs. Google, Inc., (2007)**, This ruling refused to order Google and Microsoft to list plaintiffs' site in their search results, arguing the first amendment guarantees an individual the right to free speech a term that compromise the decision of both what to say and what not to say. Just as newspapers cannot be forced to include links that they wish to exclude.

According to the mention rulings, internet speech is fully constitutionally protected. Choices on how to select and arrange the material in one's speech product are likewise protected. This full protection remains when the choices are implemented with the help of computerized algorithms. Google according to these ruling is shielded by the First Amendment, which blocks the government from dictating what is presented by the speakers or the manner in which it is presented. (Volokh- 2011)

Present cases against Google. –

At the present 35 attorney generals from several US States are accusing Google of using anti-competitive behavior to maintain its search and search advertising monopolies. Each case has a different angle and is brought by a different group of States and governing bodies in US. These cases are divided by subject so we have:

- The Search manipulation case: case that focuses on Google search, alleging that Google used three forms of anti-competitive conduct to keep its search and search ad monopolies. Deals with competitors like Apple to keep it as a default search engine, using its dominant search and marketing tool to thwart competitors in its market place and disadvantaging results for rivals who operate specialize search platforms.

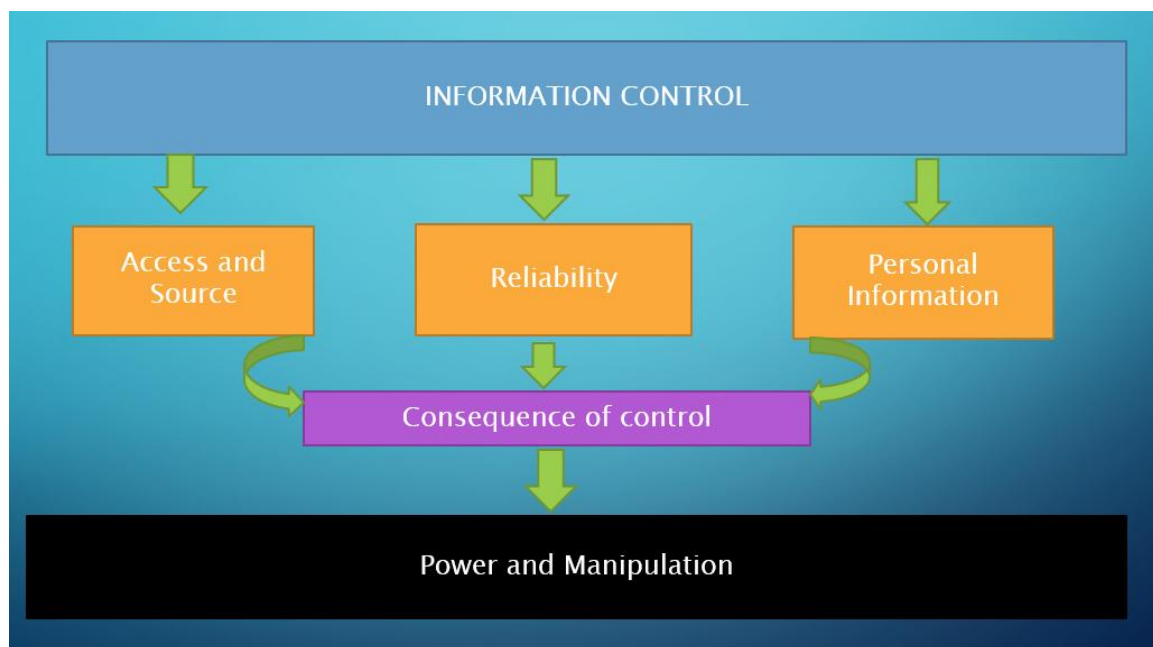
- The ad tech suit led by Texas: This case alleges anti-competitive practices that are related to Goggles Ad Technology. Arguing that Google used its monopolistic power to control pricing, engage in market collusions to rig auctions in a violation of justice. In this case it is also alleged that Google and Facebook illegally agreed not to compete with each other.
- The Federal Case: This case at a federal level argues that Google used its search dominance to preserve its other monopolies, including advertising. This suit also claims that Google was paying some companies and blocking out others to maintain its lead over competitors. Google pays Apple billions a year to make its search engine the default in the Safari web browser. Some allege that because Googles search is free for user's consumers pay the company giving their personal data. This Government case is built on the main idea that Google's dominance results in less competition, which might lead to lower-quality products. (Molla-2021)

Google has evolved from small and scrappy company to a global powerhouse that illegally protects its Monopoly. Conservatives like President Trump and liberals like senator Elizabeth Warren have called for more restrains in Big Tech. A victory of the US government in these cases could remake one of America's most recognized companies and the internet economy that it has helped define since it was founded. The US Justice department has not established remedies yet, such as selling off parts of the company or unwinding business contracts. Those types of actions are pursued in later stages of the case.

Alphabet is valued in \$1.04 trillion and has cash reserves of \$120 billion. It has fought similar antitrust lawsuits in Europe. It spent \$12.7 million lobbying in the US in 2019. The search engine case is the most straightforward, giving the US government a better chance to win. Other governments have been more aggressive toward the big tech companies. The European Union has brought three antitrust cases against Google in recent years, focused on its search engine, advertising business and Android mobile operating system. (Kang-2020)

Conclusions. –

Google is our main source of information through its search engine, we have seen how this information can be manipulated and how the ones that hold this information are holding a great power, in the chart we have prepared below, we try to explain how this information control (Access and Source, Reliability and personal information) the consequence of this information control is Power and Manipulation.



If we can do something to regain control of our information we would like to reflect with a phrase *"The best war is the one, we never have to fight"* Many similar phrases are said and quoted from famous military strategist all over the world. But they interpret this in a different matter that I will interpret it now. I understand that not fighting doesn't mean am not prepared to fight but the total opposite, it means I am always prepared for it but I use my intelligence to avoid or better said disguise it. We only have lost this "Cyber War" for the control of information if we decide there is nothing, we can do to change this. But if we choose to keep fighting then I guess we have hope of winning it.

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We have seen that to build a search engine to compete with Google is too expensive, but we have also seen that it is probable to change algorithms in order to achieve the results we want. We can think of creative ways to make new algorithms that can function selecting our information in a much more just way.

Maybe one solution can be classifying Google like a “Public Utility” and regulate it according to this. But this would mean a total new study and analyze, because it can be that this is not a good solution because we all have experiences about public utilities and in general the service quality of these is lower compared to private companies. (Thierer-2003)

Google is acting like a “gatekeeper” for the web, it influences what we are exposed to and also records it in a way. As a search engine it does have biases. Search engines design is shaped by technological, commercial and regulatory forces. The enormous cost of running a competitive search engine needed the introduction of advertising. The social and political implications of bias in the Google search engine is dependent, on how the search engine is used and the extent to which it serves as a primary gatekeeper. Some argue that the tensions between the search engine and democratic aspirations are, for the most part, not a product of malicious or even profiteering intent but instead are due to the limitations of commercialized search. These same authors even suggest that having other search engines replace Google would not solve these problems but bring similar ones. (Diaz-2008).

Although we think some of the arguments given above are in fact true, we don’t fully agree with their opinion. We agree more with the opinion that is detailed below:

Google’s monopoly over Internet search is a serious issue. Some describe the Internet as today’s equivalent to electricity. Consumers rely on the internet for their

communication, education, work, entertainment and news. Consumers deserve fair access to electricity; they should be able to access information available on the internet. But Google through its search engine is controlling access to online information like other search engines as well, denying access to useful information that consumers seek, this is called search bias and is a violation of search neutrality. Google can act in a predatory way because it has the Monopoly over internet search. Despite this behavior that affects and harms consumers so far, the antitrust enforcement agencies of US and the European Union have failed to effectively intervene. Maybe the solution would be the application of the “essential facilities doctrine” that mandates that when a monopolist holds exclusive control over a facility reserve, access must be shared as long as allowing access is practical. Examples of this are telecommunications companies ordered to share access to cable networks. Search engines have reached this level of an essential facility therefore in this case Google should be ordered to share access to its resource by fairly allowing websites to be ranked according to merit and not by whether they compete with Google. Allowing consumers access to online information and preventing Google to harm competition. Creating with this action fair competition, using Google's search engine by an actual gateway to the most relevant information users seek. (Mays-2014)

Google deprives consumers of fair competition, welfare and innovation, starving potential competitors of the opportunities and resources to create and provide viable options for society. Google should be required to end the tying of Google Search and Google Chrome to Google Play and its version of Android OS, withdraw its contracts with manufacturers that make payments conditional on exclusive pre-installation of Google Search, and stop restrictive practices that prevent manufacturers from selling devices that run on alternative versions of Android OS. All these are necessary steps to restore competition in the digital economy. (Ginsberg-2019)

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