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The Evolution of SEO in the Age of Generative Search Engines

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Master Thesis

presented as partial requirement for obtaining a master's degree in data-Driven Marketing

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Instituto Superior de Estatística e Gestão de Informação
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The Evolution of SEO in the Age of Generative Search Engines

How is the transition from traditional search engines to generative search engines (such as Google AI Overviews) impacting SEO strategies and the visibility of online content?

by

João Maria Gibert Prates de Oliveira Martins

Master Thesis presented as partial requirement for obtaining the master's degree in data-Driven Marketing, with a specialization in Digital Marketing and Analytics.

Supervised by

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STATEMENT OF INTEGRITY

I hereby declare having conducted this academic work with integrity. I confirm that I have not used plagiarism, any form of undue use of information or falsification of results along the process leading to its elaboration. I further declare that I have fully acknowledged the Rules of Conduct and Code of Honor from the NOVA Information Management School.

[Lisboa, 10/07/2025]

João Maria Oliveira Martins

DEDICATION

I would like to dedicate this thesis to my beautiful sister Carolina.

You will always be with me, in every step and every moment.

My life will always be yours too. We are going to be Masters together.

You will never be forgotten.

With deep longing,

João

ACKNOWLEDGEMENTS

"Well, it seems my turn has finally come."

I grew up listening to my older cousins talk about writing their theses, and at the time, it still felt like a distant milestone. As the years passed, that moment slowly approached, and now it has finally arrived.

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To all of you, my sincere thanks.

ABSTRACT

This research explores how the shift from traditional to generative search engines such as Google AI Overviews is affecting SEO and online visibility. The main objectives are to understand how professionals are adapting their SEO strategies, to assess the impact on website traffic and visibility, to explore how users and professionals perceive the credibility of AI-generated responses, and to analyze changes in user behavior.A literature review and a quantitative survey with SEO professionals and general users were conducted. The results show that this transition is changing both SEO practices and user habits. SEO professionals are beginning to move beyond keyword-based strategies, but few are applying Generative Engine Optimization (GEO). At the same time, users are clicking less on traditional links, since AI-generated answers already meet their needs. This means that good rankings no longer guarantee traffic, and visibility now also depends on being included in AI summaries.This study offers value by showing the current state of SEO after the arrival of generative search engines. It helps understand how professionals and users are adapting to this new reality, where visibility through inclusion in AI-generated answers is becoming as important as ranking on traditional search results.

KEYWORDS

Search Engines; Google; SEO; GEO

Sustainable Development Goals (SDG):

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LIST OF ABBREVIATIONS AND ACRONYMS

GEO	Generative Engine Optimization
NLP	Natural Language Processing
SEO	Search Engine Optimization
SERPs	Search Engine Results Page
UGC	User Generated Content

1. INTRODUCTION

"Zero-click searches are a great experience for the user. However, they aren’t ideal for websites. While some zero click results can place your brand prominently at the top of SERPs, you don’t get traffic as a reward." – Neil Patel.

In recent years, we have witnessed exponential growth in systems based on generative artificial intelligence, such as ChatGPT, launched in November 2022, Perplexity in December 2022, and Deepseek in January 2025, marking the beginning of a digital revolution in how information is searched online. These tools have quickly become alternative sources for obtaining information. Consequently, this movement has changed user search behaviour and led major search engines, such as Google and Microsoft, to redesign their platforms in order to remain competitive and relevant in this new digital paradigm (Memon & West, 2024).

In May 2024, Google announced at its annual conference the launch and integration of Google AI Overviews into its search engine, marking a significant shift in its operations and a profound transformation of the user experience. This evolution has also driven the growth of so-called zero-click searches, where users receive answers directly on the search results page without needing to access external websites, as the page itself satisfies the user’s query without requiring any additional clicks (Ye et al., 2021). While this offers a faster and more efficient experience for users, it raises significant concerns for brands and content creators, as it reduces the organic traffic directed to their websites.

According to Burton (2025), around 60% of searches on Google in 2024 resulted in no clicks, indicating a substantial shift in digital behavior. With the introduction of AI Overviews, this type of direct answer is occupying an increasing share of the search ecosystem, demanding a profound reassessment of traditional SEO strategies. In this new context, visibility on the SERPs no longer necessarily guarantees traffic, making it essential to understand the impact of this transformation on online visibility and optimization models.

Search Engine Optimization (SEO) has traditionally been one of the primary strategies for increasing website online visibility, based on the premise that the more SEO practices are applied, the more visitors a website will receive as it climbs the search engine rankings (Karyotakis et al., 2019). However, with the growth of zero-click searches and AI-generated answers, visibility no longer automatically translates into traffic, presenting new challenges to the effectiveness of conventional strategies.

The SEO strategies adopted by marketing professionals and optimization specialists are thus under pressure to evolve in light of this new paradigm. As Aggarwal et al. (2024) state, "traditional SEO methods are not directly applicable in generative search engines," which reinforces the need to adapt to new dynamics, namely optimization for AI-generated responses or Generative Engine Optimization.

This study aims to understand *how the transition* from traditional search engines to generative search engines (such as Google AI Overviews) is impacting SEO strategies and the visibility of online content. Its specific objectives are to understand how the transition from traditional to generative search engines is impacting the SEO strategies adopted by marketing professionals and SEO specialists, to assess the impact on organic website visibility and generated traffic, to explore perceptions regarding the credibility and effectiveness of AI-generated responses and generative search engines, and finally, to understand user behavior in the online search process.

In terms of structure, this research begins with an introduction of this study, followed by a literature review.

Following this, the methodology chapter describes the application of a quantitative study. To achieve this, a cross-sectional quantitative study was conducted using a structured questionnaire, which comprised both open-ended and closed-ended questions, as the primary data collection instrument. The purpose of this tool was to empirically validate the claims and trends identified in the literature review based on a representative sample.

In the results analysis chapter, the data includes the perspectives of both SEO professionals and general users. Descriptive statistics were used, with the main results illustrated through charts. The analysis also considered whether the findings confirmed or contradicted the expectations established in the theoretical framework.

Finally, the last chapter of this study presents the main conclusions, outlines its limitations, and offers recommendations for future research.

2. LITERATURE REVIEW

This chapter aims to present the main theoretical perspectives and key concepts related to the research topic. The chapter aims to provide a structured overview of how the field has evolved and the insights that can be gained from existing literature. As illustrated in Figure 1 below illustrates the flowchart presents the main topics hat will be addressed throughout the review.

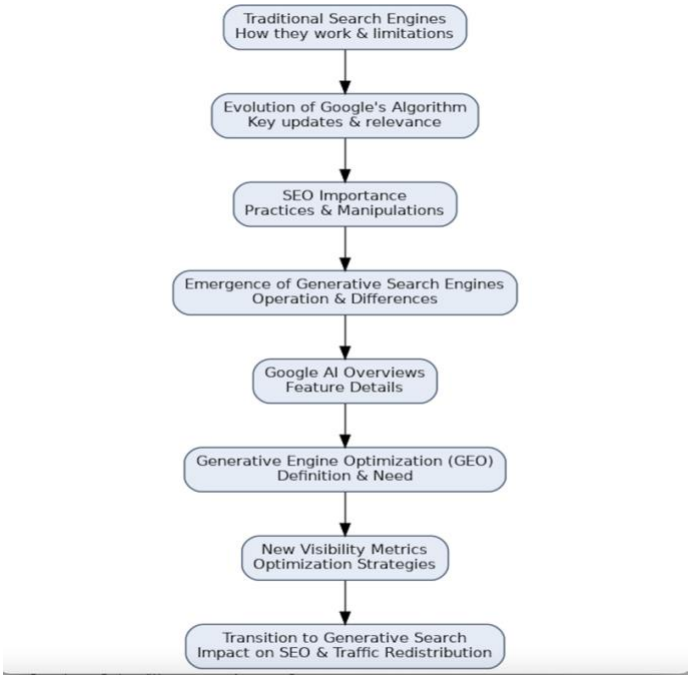

Figure 1 - Flowchart of Literature Review Topics

The review begins by explaining how a traditional search engine works, providing the reader with context and an understanding of how the ranking system operates and its limitations. Then, it examines the evolution of Google's algorithm, highlighting the significance of these updates in maintaining relevant results in the face of manipulations developed over the years to achieve top positions in the SERPs. The review also covers the importance of SEO, its practices, and manipulations. It then explores the emergence of generative search engines, their operation, and the impact and differences they have compared to the traditional search model. The Google AI Overviews feature is addressed in greater detail. Afterward, the concept of Generative Engine Optimization (GEO) is introduced as a new methodology for gaining

visibility in this new paradigm without requiring clicks, examining how it differs from traditional SEO. New visibility metrics in generative engines are also analyzed, as well as optimization strategies applicable to this type of environment. Finally, the review examines the transition from traditional to generative search engines and the impact of Google AI Overviews on SEO strategies and content visibility. It also explores how websites are losing traffic due to generative AI and how this traffic is being redirected to platforms such as Reddit, Quora, Wikipedia, LinkedIn, and Instagram.

2.1 SEARCH ENGINES

Search engines have played an indispensable role over time in mediating access between users and the vast amount of information available on the internet. They act as intermediaries that provide instant access to content considered relevant while filtering and organizing results based on algorithms trained using multiple criteria. This algorithmic logic aims to ensure that users receive the most relevant information possible within the immense universe of online content (Van Eijk, 2009). Although we often assume that search engines, such as Google, are designed to deliver the most relevant information to their users, the fact that their algorithms are not transparent raises several concerns. According to Pasquale (2015), this lack of transparency can undermine trust in the notion of relevance, making it impossible to determine whether the ranking of results reflects a genuine intention to serve the user's informational needs or, instead, a strategy to maximize the platform's profits. This is because, instead of simply presenting the most relevant content, search engines may prioritize pages that serve their commercial interests, such as advertiser-partner websites or content produced by the platform itself. As a result, what appears at the top of the search results may not necessarily be the most useful or informative but rather what is most profitable from an economic standpoint.

To understand how these systems deliver relevant results, it's essential to explore the internal mechanics behind their operation. A search engine essentially involves two main processes, the indexing process and the query process, which together organize, retrieve and present relevant information for its users (Croft et al., 2015).

The indexing process consists of 3 essential phases, including text acquisition, text transformation and index creation (Croft et al., 2015).

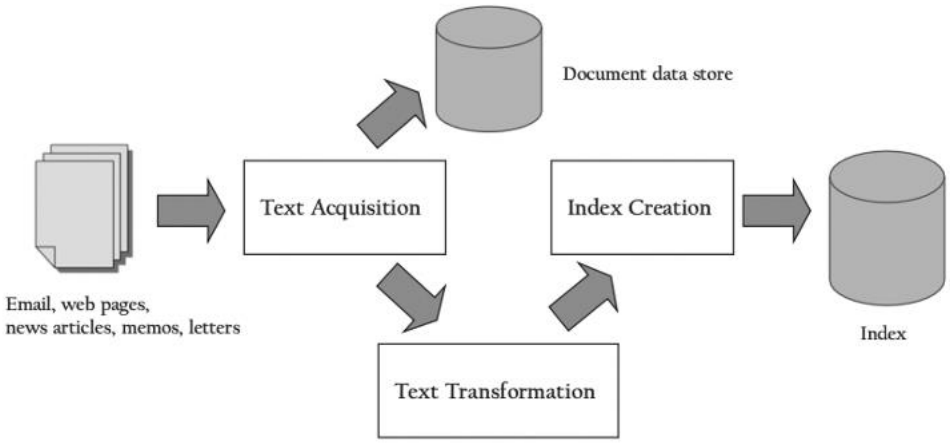

Figure 2 - Search Engine Index Process by (Croft et al., 2015).

When acquiring text, the search engine begins by collecting information and documents from various sources such as web pages, news articles through web crawlers or bots, which are algorithms developed to explore, identify, and store relevant information on the internet. (Croft et al., 2015).

The documents collected are then stored directly in a central repository, whose technical name is the Document Data Store. Once the search engine has stored the documents it has found, it begins the process of transforming the text. This process begins with normalization, which consists in the transformation of previously collected documents into index terms, parts of a document that are stored in the index and used in the search. In order for this transformation to take place, various techniques are used, such as tokenization, to divide the collected text into smaller units; the removal of stop words, such as prepositions and articles; and stemming, the function of which is to group words on a common basis, helping with search and classification by reducing the variation of words and focusing on the main concept, thus making it possible to increase the correspondence between the words in queries and the documents (Croft et al., 2015).

Additionally, in the process of transforming text in web search engines, a technique is also used to identify and process the links that are found on web pages that contain an associated anchor text, the clickable text of the links. These turn out to be fundamental in providing information about the content of the destination page and, through algorithms such as PageRank, which assign scores to pages based on the number of links pointing to them and the relevance of the content, they determine the level of importance of a page within the vast internet ecosystem (Croft et al., 2015).

Another important aspect of text transformation is the information extraction. In this process, the search engine identifies more complex pieces of information than single words, looking for more specific elements such as names of people, dates and places, rather than just focusing on simplistic words. To do this, we must use tools such as entity recognizers, which help the search engine to find this information, so that it can organize it properly to make the results more accurate and relevant, ignoring information that isn't important (Croft et al., 2015).

Lastly, still in line with the text transformation process, we have the role of classifiers. Their function is to organize documents or parts of it into categories, where it then identifies relevant information, called metadata, which is used to classify the content. In addition to this function of classifying documents with pre-defined labels, it also has the ability to group documents even if there are no pre-established categories. With classifiers, the search engine is able to show more relevant results to its users, once the documents have been classified or grouped, they are used more efficiently, they allow the system to understand the content better, consequently improving the ranking of the pages in the search results (Croft et al., 2015).

Finally, the last phase consists of creating indexes. In this phase, the information processed in the text transformation stage is properly organized into different structures (inverted indexes), the index associates the terms (keywords) with the documents in which they appear. In this way, search engines find the most relevant results for a user's search with more efficiency. They are called inverted indexes because they contain a list that, for each keyword, identifies the documents that contain it. This works in the opposite way to a traditional

document archive which, instead of listing the keywords present in each document, lists the documents associated with each keyword, making the search faster and more structured. It is important to mention that there is a component at this stage called document statistics which collects and stores statistical data on words, characteristics and documents. Data such as the frequency with which terms appear, the positions in which they appear, the number of documents in which each term appears and the length of the documents in tokens. This statistical data is stored and saved in structures called loop tables and is designed to facilitate rapid information retrieval and help determine which documents are most relevant to a query. To complement the document statistics, another important element to consider is the weight of the terms, which measures the importance attributed to each word in the documents, using the tf-idf method. This method gives more weight to terms that appear frequently in the document, indicating that they are central to its content (TF) , reducing the weight of terms that appear in many documents, such as generic words, and prioritizing more specific terms (IDF). Finally, still at this stage of the indexes, there is a component responsible for distributing the indexes across multiple servers, in order to guarantee greater efficiency and fast response times through the parallel processing that is essential in search engines that deal with large volumes of data (Croft et al., 2015).

Once the information has been properly indexed, the second core process, the query process, is activated when a user submits a search. This process is made of three processes: interaction with the user, the ranking and finally the evaluation (Croft et al., 2015).

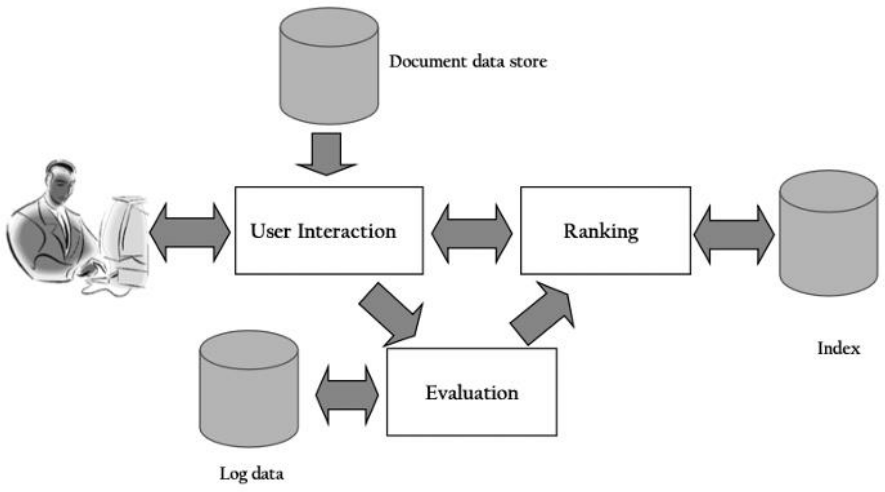

Figure 3 - Search Engine Query Process by (Croft et al., 2015).

Regarding the interaction with the user, the search engine receives and interprets, through a parser (responsible for processing the sequence of text tokens in the document to recognize structural elements such as titles, figures, links and headings), the query language made by the user via an existing interface. Queries carried out on a web search engine consist of a small set of keywords that are essential for providing context and specifying the subject of the search made. However, when users carry out longer queries, which may contain a smaller proportion of relevant keywords, they tend to have greater difficulty in presenting relevant results to their users. One of the functions of this component is to accept the user's query and transform it into index terms. For this to be possible, some of the text transformation techniques applied to documents during the indexing process (such as tokenization, stop word removal and stemming) are also applied in this context. By transforming the text of the query into index terms, it will be able to make a comparison with the existing index terms already present in the indexed documents, ensuring that the search engine is able to understand and proceed with the search on the indexes to subsequently present the most relevant results to the search term made by the user. This presentation of results to users is done through a specific component of the search engine that is responsible for displaying the documents that are most highly ranked by the ranking algorithm. This component also generates snippets (short summaries of the documents found), highlights the keywords related to the query made by the user and adds relevant advertising to the display of results (Croft et al., 2015).

As for the ranking component, it receives the duly transformed query from the user interaction phase with the search engine and generates a ranking of documents classified using scores based on a retrieval model. Scores are based on characteristics and weights related to the thematic relevance of the document in relation to the search term and its relevance to the user. The task of calculating and comparing if the scores are quick and efficient is the responsibility of the performance optimization component that allows to determine the successive ranking order. This component reinsures the most relevant documents to be processed and made available to the user (Croft et al., 2015).

The speed and efficiency of the ranking process in dealing with multiple search queries and index terms simultaneously is due to the search engine's ability to distribute its workload. This

is done through a query broker that distributes the tasks related to ranking across different servers. So instead of all the processing being carried out by a single central system, the task of processing the queries and classifying the documents is split up, allowing for faster and more efficient execution. In addition to the query broker, another form of distribution used to improve the efficiency and speed of the search engine ranking process is caching, which allows parts of the terms index that have already been ranked from queries carried out previously by other users to be stored in local memory, allowing for efficient reuse of information and significant time savings in the delivery of information to the user (Croft et al., 2015).

Finally, we have the Evaluation phase, which is responsible for the search engine's performance in terms of effectiveness and efficiency based on user interaction data collected in the query logs, such as the number of clicks on documents, viewing times and other metrics. Documents with higher click-through rates and viewing times tend to be more relevant. Using the logs, it's possible to adjust the search engines, implementing improvements such as suggesting better future queries, optimizing the correspondence between advertising and searches, among others. Another component evaluated in this phase is the effectiveness of the classification algorithm, which is measured by comparing it with alternative algorithms to see which one gives out the best results in terms of document relevance. In addition, the evaluation phase of a search engine also includes performance analysis, which measures the overall performance of the system, considering aspects such as the response time and the efficient use of computing resources, in order to ensure that the system works optimally, guaranteeing an improvement in the presentation of relevant results to users as well as greater efficiency and technical performance of the search engine (Croft et al., 2015).

Despite the complexity of the technical processes involved in indexing and the query process, as described by Croft et al. (2015), the relevance of the results presented by a search engine often does not depend solely on the efficiency of its algorithms. According to Marchionini (2006), many users struggle to clearly and effectively express what they are truly looking for. Even if algorithmic systems are highly optimised, they can still fail to deliver relevant results not due to technical limitations, but because they rely on a formulation of queries that is not always effective or aligned with the user's intent. The author points out that in exploratory

searches, users may be unfamiliar with the search domain and may not know what kind of information is available or how to ask for it. This highlights a clear limitation of traditional search engines, which, regardless of how efficient their algorithms may be, remain structurally limited from a semantic standpoint. Also, Hearst (2009) stated that they rely heavily on keyword matching and often struggle to interpret complex or ambiguous user intentions.

2.2 Evolution of Google Algorithm

In the domain of search engines, Google has become the dominant global player, holding approximately 90% of the market share. Over time, it has played a pivotal role in the way people access information, assuming responsibility for providing information, services, and entertainment to billions of users worldwide. (Lowe, 2024). With the evolution of technology and the internet, new challenges have arisen in maintaining relevant and high-quality search results. For this reason, Google began adjusting its search algorithms early on through a series of updates, aiming to eliminate potential spam practices and continually improve its users' experience (Lowe, 2024).

In addition, Mager et al. (2023) offer a complementary perspective by reinforcing the idea that Google serves as a true digital gatekeeper, shaping the way users discover, consume, and interpret online content. This dominant position implies not only a technical responsibility for delivering relevant results but also a significant impact on a social and informational level, as it involves selecting which sources gain visibility and authority in the digital space.

One of the first significant updates to Google's algorithm occurred in 2003 with the ‘Florida Update’. This shift not only marked the beginning of a more rigorous stance against manipulative tactics but also revealed an early indication of Google’s intention to shape a more trustworthy and content-driven digital environment. According to Lowe (2024), this update began to penalize websites that constantly manipulated SEO, specifically the excessive use of keywords (keyword stuffing), to inflate their rankings in search engines artificially. On the other hand, websites with relevant and quality content practices were rewarded with higher search engine positions.

In 2005, another update to the algorithm was made, the jagger update. It focused on eliminating link farms and paid links that were used to artificially manipulate the ranking of websites. This update reinforced the importance of obtaining organic backlinks, ensuring that the ranking was based on relevance and quality. In the same year, Google also made sure of making changes to its infrastructure (Big Daddy update), specifically improving the way pages were indexed and managed, issues that were related to canonicalization, redirecting pages and duplicate content (Lowe, 2024).

Years later, more specifically in 2009, Google, through the Vince update, began to prioritize credible and reliable sources in order to deliver more secure information to its users. This update benefited websites already established in the market and various world-famous brands (Lowe, 2024).

In 2010, Google once again adjusted its algorithm with the caffeine update. In this update, Google overhauled its indexing system with the aim of providing more up-to-date results. With this, Google was also able to improve the speed and efficiency of its indexing process, ensuring that all new content created was immediately available to its users (Lowe, 2024).

The following year, in 2011, through the “Panda” update, Google felt the need to crack down on low-quality sites, emphasizing the importance of original content and focusing on user engagement metrics such as time spent on websites and abandonment rates (Lowe, 2024).
To maintain relevance and quality in the presentation of results to its users, the Penguin update appeared in 2012, which aimed to combat spam, specifically artificial links with excessive optimization. It also penalized websites that acquired low-quality links, encouraging content creators to gain backlinks naturally and organically.

In 2013, to better understand the meaning and context of search queries, Google felt the need to update its algorithms again. These can focus on context and the user's search intent, rather than just analyzing keywords in isolation, representing one of the largest algorithm reformulations to date. This update, which was given the name “Hummingbird”, represented a re-engineering of Google's core algorithm to better understand the meaning behind search

queries. It introduced the concept of “semantic search”, considering the context and intent behind searches, rather than just the interpretation of keywords in isolation. For example, if a user carried out a search for “cheap Italian restaurant in New York”, the algorithm before the Hummingbird update could present results that corresponded individually to “restaurant”, “Italian” or “New York”, without considering the full intent of the query. With this update, Google is now able to understand the intent behind the full phrase, presenting results that specifically match affordable Italian restaurants located in New York. This update turned out to be an impactful one, as it led content creators to focus more on the user's search intent and on their needs (Lowe, 2024).

Later, precisely in 2015, with the growing expansion of the internet and mobile devices, Google recognized the need through the “Mobilegeddon” update to prioritize and reward websites and content creators who adapted and optimized their content to mobile devices, providing a higher quality search experience for users that focus their attention on these devices. Also, in that year, through the “Rank Brain” update, Google began to introduce an artificial intelligence system, based on machine learning, into its algorithm for the search query process, providing its users with more relevant results for queries that previously could not be found. Before this update took place, it is important to mention that the Google search algorithm was programmed manually in its entirety. With the introduction of this system, Google began to use machine learning to analyze its users' interaction with search results in order to improve its response accuracy (Lowe, 2024).

In 2018, the medic update appeared, in which the algorithms reinforced the importance of the E-A-T principles (Experience, Authority and Trust), in other words, assessing the quality of the content presented to its users. This update had a positive impact on websites in the areas of health, nutrition, well-being, and finance (Lowe, 2024).

In 2019 and 2021, Google launched three major updates - the BERT Update, the MUM Update, and the Page Experience Update - representing significant advances in terms of technology and the performance of its search engine. As far for the BERT update is concerned, the search engine is now able to understand better the context of words in complex sentences, through natural language processing (NLP) techniques based on deep learning, managing it to

understand better the context of queries and present more efficient search results, improving the search experience for its users. Regarding the MUM Update, announced in May 2021, this update has been developed to understand and process information in different formats such as text, images, audio and video. In addition, through this update, the google search engine was able to understand and process information in several different languages, meaning that when users perform a search, the google engine will be able to use content available in different languages to provide the most relevant answer possible, regardless of the language in which the search query was made previously.

Lastly, in the same year, Google announced another new update called the Page Experience Update. The aim of this update was to evaluate and put the user experience on web pages at the forefront by introducing a new set of metrics (Core Web Vitals) that were responsible for measuring relevant aspects of user behavior and experience, as well as other factors in evaluating the page experience. Some of the most relevant metrics for evaluating user experience are, for example, “Largest Contentful Paint”, which is responsible for measuring the loading time of the largest visible content element, indicating how quickly the page becomes useful to the user; Then comes the “First input Delay”, which evaluates interactivity, considering the time that elapses between the user's first interaction (click) and the browser's response. In addition to the introduction of core web vitals, as mentioned above, google has also introduced other factors when considering the experience that the page provides to its users.

In 2022, Google recognized a frequent problem that frustrated its users. Sometimes, after performing a particular search and accessing a web page, users expected to find the information they needed, but ended up with content that didn't meet their needs and expectations. To deliver authentic and informative content rather than content created only to generate clicks as an attempt to manipulate ranking positions, Google began a series of improvements and adjustments to their search algorithm, and this operation became known as the “helpful content update”. With this update, Google tried to guarantee the delivery of original, high-quality, and truly informative content to its users (Lowe, 2024).

The following year, in 2023, Google announced a new “Faq and Structured Data” update. This update consisted of limiting the enriched FAQ results, a special format that displays frequently asked questions and answers in search results only for trusted and authoritative sites, such as government and health sites, with the purpose of simplifying search results and guaranteeing more relevant and reliable information to its users (Lowe, 2024).

Additionally, in September of that year, Google decided to make a significant improvement to the 2022 update, which became known as the “Helpful Content update” previously mentioned. This update reinforced a significant improvement in the quality of the answers provided to its users, in the fight against spam and in the adjustment of the algorithm to achieve high quality results for its users. The algorithm is now more capable of filtering, it can distinguish more easily the original and highly relevant content from low-quality content that has only been manipulated and optimized for SEO without truly delivering value to its users. In addition, Google has also aimed to focus more on the user's search intent, with an additional attention on context and user behavior, in order to prioritize the most relevant and accurate results according to the needs of its users. The penalization of redundant or duplicate content, the stricter application of the E-A-T principles (Experience, Authority and Trust) and the introduction of mechanisms to identify and penalize AI-generated content that is not highly relevant and original (Lowe, 2024).

As we have seen, Google has made a series of updates to its algorithm, always looking for more efficient solutions, in the way the search engine evaluates and classifies content on the internet. These changes have been driven by technologies that have been evolving over time, such as artificial intelligence and machine learning, with the aim of delivering useful and relevant results. Although these updates have been made with the goal of improving users' search experience, they have also generated disagreements and debates between website owners, content creators and digital marketers (Lowe, 2024).

These developments highlight Google’s shift away from traditional keyword-based systems towards more advanced technologies capable of understanding, interpreting and even generating content. This evolution has not only reshaped the way users interact with search

engines but has also forced SEO practitioners to abandon outdated, manipulative tactics and embrace more strategic, user-focused approaches. Lowe, 2024).

In the next section, we explore how SEO has adapted, from the era of keyword stuffing and meta tag manipulation to the implementation of semantic search, structured data and UX-driven optimisation, in response to Google's increasingly intelligent and user-centric algorithms.

2.3 Search Engine Optimization

In the context of marketing, there are two primary methods for gaining visibility on search engines. One is paid advertising, in which marketers, website owners, and brands can pay for clicks using paid search marketing (PSM). The other is free, specifically SEO, which allows websites to achieve prominent positions on Google's results page without any associated cost. This latter option is particularly appealing to most online content creators (Lewandowski et al., 2021).

Search Engine Optimization (SEO) consists of a set of strategies and optimizations applied both inside and outside a web page, with the aim of increasing the organic visibility of a website or brand on search engine results pages (SERPs). This process consists of attracting exclusively organic and free traffic to generate conversions (Gouveia, 2022). In addition, SEO focuses on understanding how search engines, such as Google, classify and organize the results, so that it is subsequently possible to strategically optimize the brand / website to reach better search positions (Lowe, 2024).

On the other hand, it is essential to acknowledge that SEO techniques raise significant concerns regarding the results provided by the Google search engine. According to Lewandowski et al. (2021), users tend to click on the first results of Serps presented to them based on the principles of least effort and satisfaction. The former refers to the user's behavior and tendency to search for answers with the least possible effort. At the same time, the latter describes choosing an option that seems "good enough", rather than exhaustively searching for the best alternative. In practice, the authors raise the question of whether the most visible content in the SERPs genuinely reflects its intrinsic quality, or whether its prominence is merely the result of effective technical optimization. Thus, the authors critically conclude that

although SEO increases the visibility of a piece of content, this does not guarantee that it is the most useful, credible, or informative.

2.3.1 SEO On-page and Off-page SEO

According to Gupta et al. (2016), Search Engine Optimization (SEO) is divided into on-page SEO, which encompasses actions performed directly within the website, such as structure, content, and usability, and off-page SEO, which includes external strategies like backlinks and brand mentions aimed at increasing authority and driving traffic from web crawlers such as Google.

On-page SEO consists of a set of optimization strategies that are directly applicable to the pages of a given website. In other words, it is the process of improving website pages so that they are more visible and relevant to the Google search engine. According to Lowe (2024), this includes keyword research and optimization, which involves identifying possible relevant keywords that potential visitors may use in their searches and strategically integrating them into the content, titles, meta descriptions and tags. Lowe (2024) also emphasizes the importance of technical optimization, which includes improving website speed, ensuring mobile responsiveness, implementing secure protocols such as HTTPS and structuring the website in a way that facilitates indexing by Google. Additionally, it is also important to consider the user experience on the page, and therefore optimize it to create a simple and intuitive navigation, design and layout (Lowe, 2024). In addition, Marco Gouveia (2022) stated that one of the essential on-page SEO strategies is the creation of original and relevant content. A given web page should correspond to the keyword searched by the user and be closely related to the topic in question. However, the effectiveness of these strategies is not guaranteed, as they must evolve alongside search engine updates and shifting user expectations.

Off-page SEO, on the other hand, consists in a whole set of strategies carried out outside the website, playing a fundamental role in improving positioning and visibility in search engine results (SERPs). These strategies essentially focus on acquiring quality backlinks (links from one site to another), Brand Mentions and Guest Blogging, which together indicate to search engines (in this case specifically Google) the relevance and credibility of a website (Lowe,

2024). With regard to acquiring backlinks, the more quality backlinks a website has, backlinks from relevant websites, the better a web page will be positioned, since Google measures credibility by the number and quality of associated backlinks. These end up being a decisive key factor as they act as votes of confidence and can significantly influence the website's ranking (Gouveia, 2022). Another essential aspect is brand mentions. Brand mentions should be encouraged throughout the web as a way of improving the credibility and visibility of the website (Lowe, 2024). In addition, guest blogging also turns out to be an important off-page SEO strategy because writing articles on the same industry for other websites / online platforms can create valuable backlinks and, at the same time, reach new audiences, while contributing to appearing in the top positions on search engine results pages (Aryani et al., 2023).

While a distinction is often made between on-page and off-page SEO, in practice these two types of optimisation are becoming increasingly interlinked. A website with well-structured content and good technical performance may struggle to gain visibility without external signs of authority. In contrast, a site with many high-quality backlinks may struggle to engage or convert users if the content is weak or disorganised. Roumeliotis et al. (2022) note that the most effective websites integrate internal optimisations with external, credibility-enhancing strategies. Their research also revealed that the best-positioned sites prioritise not only keywords and loading speed, but also a well-organised structure, proper mobile optimisation and well-considered external links. This ultimately confirms that both the quality of the site itself and recognition by others are fundamental to success in search engines.

Although these practices still play a vital role, the evolution of user behaviour and the integration of artificial intelligence into search systems has demanded more advanced and strategic SEO approaches.This shift becomes particularly evident when we look at how SEO strategies have evolved over time.

2.3.2 SEO Strategies Over Time

Historically, SEO was relatively straightforward and susceptible to manipulation. Many website owners and content creators aimed to reach the top positions on Google by inappropriately optimising their content for the search engine instead of considering the

search intent of users. According to Zhang et al. (2014), abusive SEO practices known as 'black hat' SEO were commonly used to artificially boost rankings and gain an unfair advantage.

Many of these recurring manipulations consisted of keyword stuffing, manipulating meta tags, hiding text and links, and link farms. As far as keyword stuffing is concerned, content creators and website owners try to stuff as many keywords as possible into their content/text to achieve a better position in search engines. As for the manipulation of Meta Tags, which consist of elements (HTML commands) created to describe the content of a page to search engines, helping them to crawl it, this consisted of putting excessive keywords in the meta description, or inserting irrelevant keywords, in order to try to “trick” search engines into believing that the page is more relevant than it really is. Another recurring manipulation was the placement of “invisible” texts or hidden links on the pages of a website. These were not visible to users but were used for search engines to collect their information. Generally, owners would insert additional keywords or links to manipulate search engines into thinking that the page or content was more relevant than it was. As far as link farms, these were a network of websites that were created to generate artificial backlinks between themselves to improve SEO rankings. However, these links were often irrelevant and of no real value to users. It’s clear that techniques were effective in the short term but unsustainable, prompting Google to adjust its algorithm in order of more useful and authentic content. (Lowe, 2024).

In recent times, the digital context has evolved rapidly, undergoing profound and significant changes driven by recent technological advances. Artificial intelligence has emerged as a key element in this process, playing an essential role in the creation of search engine optimization (SEO) strategies and into the re-adaptation of websites to make them more relevant and effective for search algorithms in the age of Artificial Intelligence (Ziakis & Vlachopoulou, 2024).

Nowadays, SEO is more efficient, with a greater focus on the user experience and its satisfaction. To ensure the quality of search results, Google currently implements effective penalty mechanisms against websites and content creators who do not offer relevant and original material, capable of responding clearly and accurately to their users' search intentions. Manipulative SEO practices known as “Black Hat SEO”, such as buying backlinks, keyword stuffing, manipulating meta tags and placing invisible text, are currently controlled

and penalized by Google's advanced algorithm, and it can consequently have a negative effect on the positioning of websites and on their content in search results. In modern SEO, to improve the experience and satisfaction of its users, Google reinforces and values the creation of original, informative and relevant content that demonstrates authority and real value. (Lowe, 2024).

Another aspect of modern SEO is semantic search and LSI (Latent Semantic Indexing) keywords (Lowe, 2024). Through LSI, it is possible to accurately match queries to documents by understanding the context and meaning behind the words, rather than just relying on keyword matching (Jaber et al., 2011). Therefore, in today's SEO, these keywords are understood as terms that enrich the content by providing additional context. Including related and contextually relevant terms in this type of content helps search engines to better understand the subject matter, improving the relevance and accuracy of search results. In addition, this method ultimately encourages the creation of content that addresses topics in a complete and in-depth manner, rather than resorting to the excessive use of keywords. So, by doing this, texts become more relevant and of higher quality for readers (Blynova, 2019). Optimization for mobile devices and user experience (UX) are a crucial factor in the era of modern SEO. The increasing use of mobile devices to access information available on the internet has led to the need to optimize content not only for desktop, but also for mobile devices. As a result, website owners and brands must present a responsive and flexible design that is able to offer an intuitive experience to their users on different devices. To provide a better user experience, it is important to ensure that the site has a clean design, is fast, easy to navigate and keeps visitors engaged, reducing the bounce rate necessary. By meeting these conditions and implementing the necessary optimizations, performance in the Google rankings can improve significantly (Lowe,2024).

Optimization for mobile devices and user experience (UX) are crucial factors in the era of modern SEO. The increasing use of mobile devices to access information available on the internet has led to the need to optimize content not only for desktop, but also for mobile devices. As a result, website owners and brands must present a responsive and flexible design that is able to offer an intuitive experience to their users on different devices. To provide a better user experience, it is important to ensure that the website has a clean design interface,

loads quickly, is easy to navigate and keeps visitors engaged, reducing the bounce rate and improving search rankings (Lowe, 2024).

Moreover, content quality continues to play a central role in ranking success. Krrabaj et al. (2017) also stated that content is the most important factor in determining a website's position in search engines. This perspective is reinforced by Killoran (2013), who highlights that the sustainability, visibility and long-term traffic of a website depend primarily on its content. These insights underline that although technical and UX optimisations are vital, they must be aligned with the creation of relevant and valuable content that meets the expectations of users.

Another aspect to consider is the structured data and Schema Markup. These are essential factors for improving the visibility and accessibility of content on the Internet to search engines. Schema markup, a form of structured data, allows content to be described in a standardized way, making it easier for search engines such as Google to better understand and index the information. Both brands and website owners should take these practices into consideration, leading to the improvement of the search rankings and the following increase of click-through rates (Edgar, 2023). Websites must be secure as modern users prioritize the security of their data. As a result, Google requires the use of HTTPS, to ensure that its users' data is properly protected and secure. (Lowe, 2024).

For local online businesses with a physical presence, local SEO plays a major role. Business owners must know how to optimize their websites for local searches to increase their visibility in specific geographical areas. In addition to creating relevant content with expressions and terms local to the region that potential users are likely to search for, we must focus on Google core web vitals such as site speed, mobile friendliness and intuitive navigation. Acquiring backlinks from local websites with a high reputation in terms of credibility and authority, optimizing the google business profile through accurate information, attractive images and regular updates, and finally, the importance of positive reviews, which can have a significant impact on google rankings (Gaida & Konhaeusner, 2024). Additionally, when we talk about modern SEO, we can't forget the importance of creating content marketing and integrating with social networks. Although it does not directly influence ranking factors, it can influence search visibility and brand awareness (Lowe, 2024).

This evolution of SEO from the days of keyword stuffing and link farms to the development of user-focused practices and optimizations reflects the evolution and changes in the way search engines like Google operate and prioritize to deliver relevant, credible and original information/content to their users, while continuously improving their experience. Modern SEO ends up being a continuous process in which it is necessary to keep the algorithm updated and evolving, just like the industry trends and changes in user behavior. In this way, all SEO practitioners must constantly adjust and readjust, if necessary, all their strategies to remain competitive in the digital environment (Lowe, 2024).

However, traditional SEO methods are not directly applicable to generative search engines, since unlike traditional search engines, which are limited to keyword matching, generative search engines require new optimization techniques, entering a new paradigm in which website owners and content creators seek to increase their visibility in generative search engine responses. (Aggarwal et al., 2024)

2.4 The Emergence of Generative Search Engines

Currently, searching for information online has become a more complex and demanding task, bringing new challenges to traditional search engines. These challenges stem not only from the overload of available information, which often leads to user dissatisfaction, but also from the evolution of user needs. Nowadays, users carry out more elaborate and demanding searches, which limits the ability of conventional search engines to provide relevant and effective answers (Zhou & Li, 2024).

Instead of directing users to websites containing the answers they are looking for, these systems provide a direct and tailored response to the question asked. According to Haider and Sundin (2019), this new type of system is changing the traditional way of searching the internet and may even surpass widely used search engines such as Google.

While generative search engines have gained prominence by providing quick, concise answers and offering a new way to access information, it's important to recognise that this evolution poses significant challenges for websites and content creators. According to Aggarwal et al. (2024), despite the increase in traffic and usefulness for users, content creators face a new reality because these engines' workings are not fully clear or accessible to the public. The fact

that they are constantly changing and evolving also influences the control that content creators have over how and when their content appears in generated responses. The lack of transparency that has already been discussed by several authors in the context of traditional SEO continues to persist in this new digital paradigm of generative artificial intelligence search engines.

2.4.1 The Impact of Generative AI on Search Engines.

These new demands have exposed the limitations of conventional search engines, paving the way for innovative approaches driven by artificial intelligence. Through the emergence of Generative AI, question answering systems such as Chatgpt have changed the way users search and obtain information, becoming innovative and alternative methods that have significantly impacted traditional search engines such as Google.

To keep up and remain relevant and competitive in the market, major search engine technology companies such as Google and Bing began integrating Generative AI into their platforms, with the launch of Google Search Generative Experience (SGE), later known as Google AI Overviews, and Bing Chat, entering in a new era of generative search engines. This shift prompted major tech players to adapt quickly, integrating generative AI into their platforms and giving rise to a new generation of hybrid search systems.(Memon & West, 2024).

Generative search engines are different from traditional engines because they use Large Language Models (LLMs). These LLMs not only can find information from keywords, but they can also generate original and coherent content, allowing for more complex and intellectually demanding tasks to be executed (Suri et al., 2024). LLMs are statistical models of natural language and function as sophisticated “next word predictors”. Unlike traditional engines that store and retrieve data directly and objectively, LLMs are known for processing information in a more complex way. In other words, instead of just accessing previously stored data, LLMs learn patterns and relationships from large volumes of text, allowing them to generate innovative and appropriate responses to the context presented. This does not mean that these models have the ability to reason or think like human beings, they are just formatted to combine contextually relevant words to produce an apparently coherent, personalized and

possibly original response for users (Memon & West, 2024). In addition, the emergence of large language models has allowed generative models to gather and summarize information from various sources to answer user queries (e.g. Google AI overviews) (Aggarwal et al., 2024).

By combining advanced language processing with predictive capabilities, LLMs enables a more dynamic and contextualised interaction with information. However, the ability to combine sequences of words, without fully understanding their meaning, can result in the generation of incorrect, inaccurate, or unpredictable information. This technical phenomenon, known as “hallucination”, is something that can occur. These “hallucinations” are often associated with numerous factors that arise in the training and generation processes. These include training data quality and diversity, model architecture and size, task complexity and the dynamic nature of language model reasoning (Cleti & Jano, 2024).

Regarding training Data Quality and Diversity, this factor has a significant impact on the model's ability to produce an accurate and properly contextualized result. In a scenario influenced by biases or imbalances in the training data, it can lead to the generation of “hallucinations” on the part of the LLMs. The size and architecture of the LLM is also a contributing factor. Models that are presented in a significant size naturally end up having a greater capacity for storing and processing information, while at the same time giving them a greater ability to deal with many different types of topics, generating more complex responses. However, the greater the complexity, the greater the risk of generating incorrect information or “hallucinations”. This is due to the size of the LLM increasing the likelihood of it connecting information incorrectly and with less precision in the answers generated (Task Complexity). Finally, it was concluded that the reasoning processes in LLMs are static and dynamic. Although this dynamic allows for greater flexibility and variability in the generation of answers, it ends up making it difficult to analyze and understand the “hallucinations” of the models (Cleti & Jano, 2024).

“Hallucinations” can, therefore, lead to truly significant impacts. In certain critical areas such as health and journalism, the misinformation generated by LLM hallucinations can lead to serious consequences and lead to compromising the veracity and reliability of the information

(Cleti & Jano, 2024). In addition, when hallucinations occur and the information is shared on the internet, it can lead to users distrusting the content that LLMs produced (Wu et., 2024).

A lack of critical thinking among users who rely on generative search engine results can affect trust in the presented information. In some situations, users simply accept the information shown to them at the time of the search without questioning it, which can lead to incorrect content being spread. This issue is intensified by the limitations of generative search engines themselves, which sometimes generate incorrect information or cite unreliable sources, thus reducing their credibility (Cleti & Jano, 2024). Furthermore, Capra and Arguello (2023) found that many users interpret content containing native advertising as purely informative and neutral, without realising that it contains underlying promotional messages. This suggests that the problem lies not only in the content generated by AI, but also in users' ability to understand the type of information they are consuming. A lack of knowledge about how online content is produced and presented consequently leads people to believe and share AI-generated information without questioning its accuracy.

In traditional search engines, such as Google, they discover and classify pages containing information relevant to a search. Without designing new information, presenting (in the case of a search as a direct question from the user) an answer box at the top with a quote taken from a credible and identifiable source. However, with the introduction and incorporation of LLMs into traditional search engines, new challenges arise, since LLMs are prone to hallucinations. When these models are used in the search engine, it looks for pages related to the user's search, extracting the most relevant information and parts, and fully adjusting this information to the search, to later use the LLMs that create an answer to be delivered to the user. This process, known as Retrieval Augmented Generation (RAG), aims to reduce hallucinations by creating answers from reliable sources (Memon & West, 2024).

These systems make it possible to search and incorporate real-time data into large-scale language models (LLMs), providing a well-founded and concise summary, in contrast to traditional search engines, that are based on presenting a ranking (Pradeep et al., 2024). Nevertheless, this method can make mistakes, such as decontextualizing information from a reliable source. We call this type of error a “hallucination of factuality”, however this does not

mean that the model is producing something from scratch. In fact, it just failed to understand or present the full context (Memon & West, 2024).

It is very important to understand that, with the advance of Generative Artificial Intelligence, a variety of research models is emerging. One of these models is very similar to ChatGPT, it is based on a system of answers and questions without using traditional research methods. The other model is a hybrid, combining traditional search systems with question-and-answer mechanisms. Among the different implementations of generative AI in search, Google AI Overviews stands out as one of the most prominent and influential examples. (Memon & West, 2024). The following section examines how this feature works and what it represents for the future of search.

2.4.2. Google AI Overviews

Google is currently implementing the hybrid model system in its search engine, with the recent launch of “Google AI Overviews”. This feature, announced in May 2023, represents a significant change in the way Google processes and presents information for its users (Lowe, 2024).

Google AI Overviews provides users with a concise, artificial intelligence-generated answer to their search, directly on the results page, making Google a more comprehensive and complete search engine. These answers are generated through advanced machine learning models designed by Google itself, in which they are previously trained using various data sets to be able to understand and generate human-like answers. These models can interpret complex queries, efficiently understand the context and synthesize information from various sources, ultimately providing an accurate and relevant response to their users (Lowe, 2024).

In more specific terms, there are four phases to the Google AI Overviews process, including query interpretation, information retrieval, content synthesis and presentation. Regarding query interpretation, the search engine interprets the intention behind the user's search by dividing the query into components and understanding its context. For example, a search for “best Italian restaurants in New York” requires the system to understand the user's intention of finding the best Italian restaurant options in a specific location. Once the query has been properly interpreted, Google's AI models begin to search for relevant information in the vast

index of web pages, initiating the next stage of information retrieval. At this stage, after gathering the relevant content, the system selects those that will be considered and used to formulate the response to be delivered to the user. During this process, AI gives priority to authoritative and credible sources, ensuring that the information provided is reliable and useful for the user. This is followed by the content synthesis process, where AI summarizes the previously selected and retrieved information into a coherent and concise overview. This includes summarizing key points, extracting essential details and presenting the information in a user-friendly format. Finally, in the presentation phase, The AI-generated answer is presented at the top of the search results pages (Annex A), allowing users to quickly find the information they have searched for, without having to click on the various links displayed (Lowe, 2024).

The introduction of Google AI Overviews represents a strategy by Google, with the main goal of integrating advanced artificial intelligence into its search engine. Through this feature, the company aims to improve the user experience by offering more accurate and relevant information. However, this new feature has generated debate among content creators and marketing professionals. Although it has significant improvements in terms of search engine efficiency and user satisfaction, this change could have significant implications for web traffic, content creation and to the overall structure of the internet (Lowe, 2024).

As Google AI Overviews becomes increasingly integrated into the search experience, it introduces new dynamics in how content is surfaced. This shift has given rise to a new set of optimisation strategies known as Generative Engine Optimization, or GEO.

2.5 Generative Engine Optimization

In the past, when traditional search engines started to appear, such as Google, to provide the chance for content creators and website owners to improve their visibility and appear in the top positions of the search engine results page, the need for them to optimize their content for the search engine emerged, and for this the process we call SEO. However, with the advance of technology, and the integration of generative artificial intelligence into traditional search engines such as Google did throughout the launch of its new Google AI overviews feature, the digital landscape has changed majorly. This is because traditional SEO methods

are not directly applicable in generative search engines since, unlike traditional search engines, the model in generative engines is not limited to keyword matching. This is why new techniques such as Generative Engine Optimization (GEO) have emerged. This process consists of a new paradigm in which content creators seek to increase their visibility (or impression) by generating responses through these generative engines (Aggarwal et al., 2024).

In traditional SEO, a website's visibility is assessed based on its average position in the results of a set of searches. However, with the emergence of generative engines, new metrics are needed to measure this visibility. Unlike traditional search engines that present an ordered list of links, generative engines combine information from various sources into a single and unique response. As a result, there are several factors that influence the visibility of a cited source within these answers (Aggarwal et al., 2024).

From the generative engine's point of view, the goal is to maximize the visibility of the most relevant citations for the user's query by measuring the relevance of the citation in relation to the search made. In the context of generative engines, a citation refers to the mention of a website within the AI-generated response. Instead of just presenting a direct link, AI can extract information from different sources and combine it into a single answer, influencing how the content will be presented and discovered (Aggarwal et al., 2024).

A relevant example is “Google AI Overviews”. Although it is not a pure generative search engine, it is a feature integrated into a hybrid search model (Google), combining traditional search with generative artificial intelligence. This system generates concise, AI-assisted answers, working in a similar way to a generative search engine (Aggarwal et al., 2024).

Understanding the concept of GEO is essential, but applying it effectively requires new ways of measuring success. The next section introduces the key visibility metrics that help evaluate performance within generative search environments.

2.5.1 Visibility Metrics in Generative Search Engine

While metrics like impressions and ImpressionRank have played a central role in traditional SEO, measuring how many times a site appears on search engine results pages. Today, search

engines like Google operate in a hybrid model, where traditional links coexist with new AI-generated answers known as AI Overviews. (Bar-Yossef et al.,2009).

In this new format, alongside the usual list of results, users find summarized answers that integrate content from multiple websites, often with specific citations directly extracted from those sites. This means that a website's visibility no longer depends solely on appearing in a result listing but also on the impact and manner in which its content is referenced in AI-generated responses.(Aggarwal et al., 2024).

Therefore, new ways of measuring visibility have emerged to better suit this new context. It is no longer enough to count how many times a site appears in results; it is also necessary to understand how much of the site's content is used in the answers and where within the response this content appears. For example, if it appears near the beginning, where it is more easily seen and tends to capture more user attention. This privileged position is important not only for user perception but also because it influences the selection of content for AI Overviews, which favor sources considered more relevant and reliable in the opening lines of the answer.(Aggarwal et al., 2024).

In this new paradigm, a new set of useful visibility metrics has emerged for content creators and website owners considering factors such as the size of the cited part, the uniqueness of the citation and the way the website is presented, all of which contribute significantly to its visibility. These metrics were developed to evaluate the impact of citations within the responses generated by artificial intelligence (Aggarwal et al., 2024).

The first metric is called word count, and it is responsible for measuring the number of words associated with a given citation, the greater the number of words taken from a website and used in the response, the greater the visibility of that site. In other words, if a website contributes to most of the content of a response, its citation will have a significant and relevant impact. However, this metric has a limitation because it doesn't consider the position of the citation in the answer. This turns out to be a limitation because users tend to pay more attention to the first few sentences, making the position of the citation an important factor that this metric ignores (Aggarwal et al., 2024).

To overcome the limitation of the previous metric, another measure has emerged, it's the Position-Adjusted Word Count. This feature gives greater weight to citations that appear at the beginning of the answer, since users tend to pay more attention to the first few sentences that appear after their search. So even if a website has fewer words cited, if its reference appears at the top of the answer, it may achieve greater visibility than a website cited only in the middle or at the end of the answer. This model is based on studies showing that click-through rates on traditional search engines follow a power law distribution, where the first results receive significantly more attention than the last ones (Aggarwal et al., 2024).

In addition to these metrics, "Subjective Impression" was also developed as an innovative approach to evaluate the impact of citations in user-generated responses. While the previously mentioned metrics focused only on quantitative aspects, such as the total number of citations included, this metric seeks to understand the real value of citations in the user experience. It considers various qualitative factors such as the relevance of the citation to the query, the influence of the cited source, the uniqueness of the information presented, the position and frequency of citations in the response, the likelihood of the user clicking on the reference and the diversity of the sources used, that influence the user's perception of the usefulness of the referenced sources (Aggarwal et al., 2024).

This approach allows for a more precise evaluation, considering how users perceive and interact with the referenced sources. With these new metrics in mind, content creators and SEO professionals can begin to adapt their strategies. (Aggarwal et al., 2024). The following section explores practical optimisation techniques designed specifically for generative search engines

2.5.2 Optimization Strategies for Generative Search Engines.

When it comes to Generative Engine Optimization, there are several strategies to consider so that content creators and website owners can achieve greater visibility and relevance in generative search engines or hybrid models such as Google. When creating content, it is essential to ensure the creation of authoritative content aligned with E-E-A-T principles (experience, expertise, authority and trustworthiness), in particular the drafting of more persuasive and credible texts. You should also include statistical data / quantitative data

rather than qualitative data. The inclusion of keywords related to the user's search should be maintained, as is expected in SEO. Besides, relevant citations and quotes from credible sources should be added with up-to-date sources to validate your claims. In addition, the website should use simple, intuitive language and include diverse content, such as blog articles, videos and interactive materials. This will help to retain the audience and align with artificial intelligence's preference for multiple formats and be properly optimized to ensure that the text on the website flows smoothly and Moreover, the use of unique and long-tail keywords allows for a conversational tone, which can further enhance the relevance of the content. It is important to mention that this type of keyword (long-tail) reflects the natural way people search for information online, making it easier for AI systems to match user queries with contextually appropriate content. (Aggarwal et al., 2024).

Furthermore, it is important to strategically define the distribution of content. According to Adame (2024), to ensure greater visibility in the age of artificial intelligence, content must be present on different platforms to reach different audiences. The more visibility your content has across multiple channels, the greater the chance that AI will recognise and elevate it. Additionally, consider optimising and adapting content for social networks, Reddit and Quora, and encourage user-generated content (UGC) to guarantee greater brand authenticity and credibility.

As Adame (2024) has demonstrated, tools such as Semrush AI Overview Tracking (see Annex B) can be used to measure the visibility of content in Google AI Overviews. These tools make it possible to analyse performance on a large scale, even when not all keyword data is fully integrated. In addition to Semrush AI Overview Tracking, there are free extensions that enhance your ability to analyse the visibility of generative search engines, specifically Google AI Overviews. The Google AI Overview Impact Analysis extension (see Annex C) enables you to monitor AI Overviews and the sources cited for various keywords, helping you to identify trends and continually adjust your content strategy. Google AI Overview Citation Analysis (Annex D) can be used to compare the links cited in AI Overviews with the results of traditional SERPs through a side-by-side view.

As these new optimisation strategies gain traction, they are already beginning to reshape SEO practices and influence how visibility is distributed online. (Lowe, 2024). The next section

examines the real-world consequences of this shift, particularly the impact of AI Overviews on website traffic and online content visibility

2.6 Impact of Google AI Overviews on SEO Strategies and Content Visibility

With the introduction of Google AI Overviews at the top of Google's search results, users feel less and less need to go to websites, as they can find the information they need directly on the results page. This significantly reduces the click-through rate on traditional links, especially affecting content creators and small website owners who rely heavily on organic traffic. In addition, another negative impact of Google AI Overviews is that they often gather information from different sources and summarize it in a single answer. While this has its advantages for users, it can also generate problems for content creators and website owners, as it is not always clear where the original information came from. Although Google includes links in the generated overview, they are usually presented in a low profile, reducing the recognition and traffic to the sites that produced the content. In fact, small websites that are overly dependent on organic traffic are particularly vulnerable to the changes brought about by Google AI Overviews. With AI-generated answers being integrated into Google's results page and gaining priority and preference from users, many small sites may find it difficult to compete with larger and more established sources that are more likely and suitable to be highlighted and referenced in Google AI Overviews (Lowe, 2024).

The introduction and subsequent integration of this new feature into the Google search engine has changed and required new content strategies for content creators, brands, and website owners, in order for them to remain relevant and visible in search results. On the other hand, this feature could improve the user experience by providing faster and more accurate responses to searches, resulting in greater user satisfaction and engagement with Google. Beyond the overall decline in website traffic, another noticeable effect of AI Overviews is the redistribution of visibility across the web. (Lowe, 2024).

The most recent updates to Google's algorithm and the subsequent integration of Google AI overviews have led to a redistribution of online traffic, benefiting various platforms such as Reddit, Quora, Wikipedia, Instagram and LinkedIn, while substantially harming small websites, specialized sites or niche blogs, and the media. Reddit, naturally favored by these recent

updates, showed an exponential growth of 126%, gaining more and more prominence for its ability to be an authentic and valuable source of information for Google. Its structure, based on user-generated content and community engagement, real time updates and a high level of engagement, is in line with Google's objectives and vision of providing their users with genuine and relevant information, discussions and reviews. Quora, frequented by users who are experts and enthusiasts in various specialties, has benefited from its quality question and answer model, while Wikipedia has strengthened its position due to its credibility and properly organized structure. The rise of these platforms such as Reddit and Quora is due to the growing appreciation of authentic user-generated content rather than highly produced commercial features providing genuine experiences and a greater trust in the community. In addition, these platforms cover a considerable number of diverse topics, providing detailed and up-to-date answers, meeting the values demanded by Google in terms of content quality and relevance. Instagram saw an increase in traffic due to a greater prioritization of visual content, stimulated by the impact of influencers. LinkedIn, on the other hand, grew thanks to its focus on authoritative content by specialized professionals. On the other hand, small and independent sites have lost their visibility, directly affecting their revenues and sustainability. Niche blogs and specialized sites have also suffered, often being overshadowed by larger platforms. Even established media like the New York Magazine have seen significant drops in their traffic results, forcing them to review their content strategies (Lowe, 2024).

Overall, these changes reveal the complexity of the digital ecosystem, requiring a continuous adaptation to Google's guidelines to maintain visibility and relevance online. For content creators, the key to staying relevant is to focus on authenticity, interaction and adapting to constant Google's algorithm changes (Lowe, 2024).

3. METHODOLOGY

The objective of this study is to understand how the transition from traditional search engines to generative search engines (such as Google AI Overviews) is affecting SEO strategies and the visibility of online content. To achieve this, a cross-sectional quantitative study was conducted based on a structured questionnaire with both open-ended and closed-ended questions as the primary data collection instrument. The goal of this instrument was to empirically validate the claims and trends identified in the literature review using a representative sample.

The primary method used was an online questionnaire designed with branching logic. Questions were adapted based on the participants' answers, allowing the survey to adjust according to their level of knowledge regarding the study's topic. The research began with a literature review aimed at providing contextual background through the exploration of concepts, trends and the perspectives of various academic authors. The construction of the questionnaire followed this based on the key ideas identified and, subsequently, by the descriptive statistical analysis of the collected data.

Data collection took place between May 10 and June 10, with the questionnaire remaining available online throughout the month. It was distributed via various digital channels, including exclusive WhatsApp communities for SEO and Digital Marketing professionals, as well as LinkedIn, Instagram, and Facebook. All participants were informed of the study's objectives, and their participation was entirely voluntary and anonymous. No personal data were collected, ensuring compliance with the ethical principles established by NOVA IMS. Ethical clearance was confirmed by a declaration from the institution, available in Appendix A.

The online questionnaire enabled it to reach a diverse audience, including both general users and SEO/Marketing professionals, allowing for the collection of relevant quantitative data from a representative sample. The instrument was developed based on scientific sources, such as Dewaele (2018) which recommend the combined use of open- and closed-ended questions

to capture different dimensions of perception. The questions also reflected the various perspectives explored throughout the literature review.

To ensure the reliability and validity of the instrument, a pilot test was conducted to improve the questionnaire's structure and clarity based on participant feedback. This test helped identify errors, rephrase ambiguous questions and improve the logic of the branching paths. The pre-test included both general users and professionals in the digital marketing field who volunteered to contribute to the quality of the instrument.

The questionnaire was developed to accommodate the varying knowledge levels of each respondent. The question "What is your profession?" served as the initial filter, offering two response options: "SEO / Digital Marketing" or "Other". Those who selected the first option were directed to a set of technical questions designed to explore their perceptions as professionals in the field (Appendix B). Those who selected "Other" were directed to more general questions focusing on their perceptions as regular users of search engines without including technical content related to SEO or digital marketing (Appendix C). It is important to note that professionals also answered the same questions as general users, in order to capture their perspectives as regular internet users when accessing information.

Thus, participants in this quantitative study are divided into two main groups: Digital Marketing / SEO professionals and general users, the latter defined as individuals who use search engines to access information online. The first group contributed their technical knowledge and practical experience on the subject, while the second group offered relevant insights into changes in search behaviors and habits.

A total of 277 valid responses were collected, comprising 80 from marketing and SEO professionals and 197 from general users. Participants were recruited through digital channels, including WhatsApp communities, LinkedIn, Instagram, and Facebook.

The sample includes respondents from various age groups, ranging from 18 to over 56 years old. The most represented age group was 18 to 24 years, with around 81 participants. The branching logic applied in the questionnaire enabled the implementation of exclusion criteria. For example, if a general user indicated that they did not frequently use search engines like

Google or ChatGPT to find information, they were redirected to a follow-up question: “When you do not use traditional search engines, what alternative sources do you use to access information online?”. After answering this question, the questionnaire was automatically closed, as it was considered that their responses would not be sufficiently relevant to the objectives of this study.

For the analysis of the collected data, descriptive statistics were applied using SPSS software to generate frequency tables that helped characterize the questionnaire responses. Additionally, charts were developed to enhance understanding and visualization of the data, using the Visme.CO platform for their creation. Additionally, the analyses, were organised and divided between SEO professionals and general users, with various structured analysis topics being created accordingly sufficiently relevant to extract meaningful insights that supported the study's conclusions.

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4. RESULTS AND DISCUSSION

This section presents the results obtained from data collected by the questionnaire. The results contained both the perspectives of SEO professionals and general users. We used descriptive statistics, with the main findings illustrated through frequency tables and charts. Comparisons are made between respondent groups to better understand the subtle differences in these ongoing changes. The analysis also considers whether the findings verify or invalidate the expectations raised in the theoretical framework.

5.1 User Analysis Survey Results

This section presents an analysis of responses provided by general users. The survey was conducted between 10 May and 10 June, with a sample size of 197 professionals. As shown in the figure below, the analysis is organised into six key thematic areas, which are based on the structure of the questionnaire as demonstrated in the figure below.

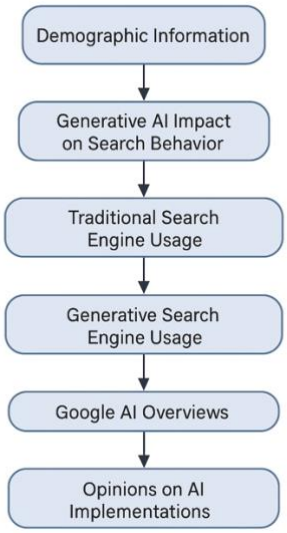

Figure 4 – Flowchart of General Users Survey Topics

This flowchart outlines the main topics that will be addressed in this section, namely Demographic Information, Generative AI Impact on search behavior, Traditional Search

Engines Usage, Generative Search Engine Usage, Google AI Overviews and Opinion on AI Implementations.

5.1.1 User Results Analysis: Demographics Information Results

This subsection begins with an examination of the demographic profile of the respondents, focusing particularly on age distribution. Knowing the age of the participants is important for understanding their behaviours and perceptions regarding the use of traditional and generative search engines.

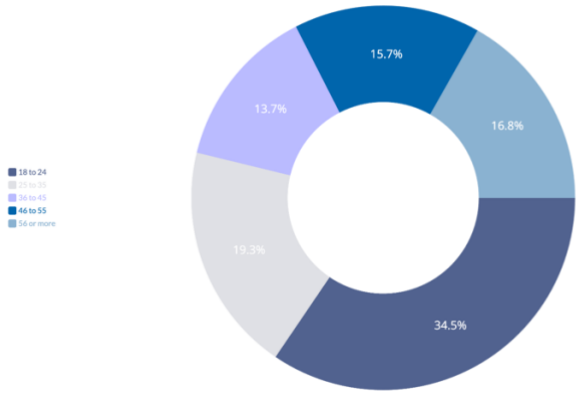

Figure 5 – Age Distribution of Users

The majority of participants are below the age of 36 (53.8%), with the 18-24 age group constituting around a third of the sample (34.5%), and the 25-35 age group comprising 19.3%. This suggests that young people are more likely to participate in this type of questionnaire, possibly because they are more familiar with the digital environment. Nevertheless, a considerable proportion of the population is composed of older age groups, with 13.7% falling within the 36 to 45 age segment, 15.7% between the ages of 46 and 55, and 16.8% aged 56 and above.

5.1.2 User Results Analysis: Generative AI Impact on Search Behavior

The aim of this topic is to understand how generative AI is influencing users' search habits, such as how they look for information and whether they use traditional search engines. It also aims to understand whether users trust AI answers and their perceptions of the technology's benefits and risks.

We begin by analysing users' perceptions regarding the impact of Generative Artificial Intelligence on the way people search for and access information online as llustrated in the figure 6 below.

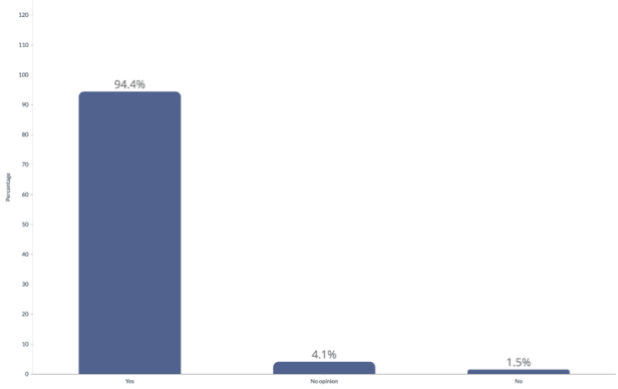

Figure 6 – Answer to the question: Do you believe that Generative Artificial Intelligence is transforming the way people search for and access information online?

Most respondents (94.4%) believes that generative artificial intelligence is changing the way people search for and access information online. Only 1.5% disagree, while 4.1% have no opinion. This degree of consensus indicates a highly homogeneous perception of AI's influence on daily digital life and aligns with the literature, which highlights how generative AI is reshaping online search behaviour and addressing the limitations of traditional search engines (Zhou & Li, 2024; Memon & West, 2024).

In order to gain a better understanding of the impact of generative AI on search habits, respondents were asked whether they use generative search engines (such as ChatGPT) more frequently than traditional search engines (such as Google) to access information online. As shown in the figure 7 below, the aim of this question was to establish whether these tools are replacing or complementing traditional search methods in users' daily routines.

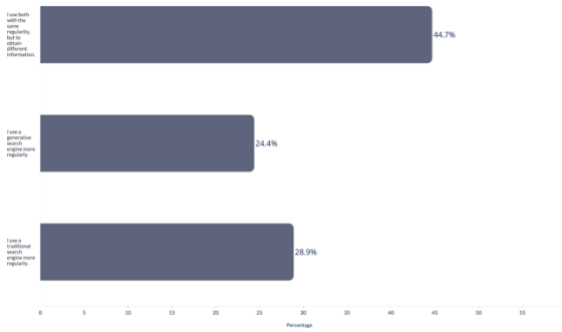

Figure 7 – Answer to the question: Do you currently use generative search engines (such as ChatGPT) more often than traditional search engines (such as Google) to access information online?

As can be seen, 44.7% of respondents use traditional and generative search engines equally often, according to the results. On the other hand, 28.9% favour traditional engines and 24.4% favour generative ones. These statistics demonstrate a shift in search practices, whereby the selection between the two categories of engines is determined by the nature of the information being sought. The combination of both may be associated with the limitations that conventional engines feel in more complex searches, even though they continue to play an essential role in accessing information.

Another aspect we aimed to explore was whether our respondents felt that the growing use of AI-generated answers, such as those provided by Google AI Overviews or ChatGPT, had reduced their need to consult traditional information websites.

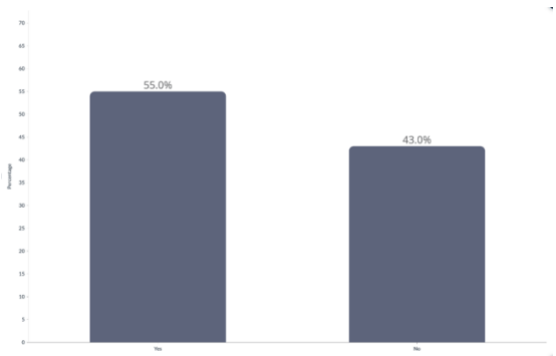

Figure 8 – Answer to the question: In your opinion, has the growing use of responses generated by artificial intelligence (such as Google AI Overviews or ChatGPT) reduced your need to consult traditional information websites to obtain information online?

As can been seen, the tendency to obtain information through answers generated by artificial intelligence was indicated by 54.8% of the 197 participants surveyed. At the same time, 43.1% of users said that they still regularly visit websites for information, even when they can get answers from AI. This highlights the coexistence of emerging technologies and established verification practices, with many users still validating information through traditional websites despite the growing use of AI-generated answers.

Another important aspect we aimed to explore was the perceived reliability of generative search engines. As shown in the Appendix D**,** 54.8% of respondents stated that they had encountered erroneous or miss contextualized responses in generative search engines such as Google AI Overviews. In contrast, 31% stated they had not experienced this issue and 12.2% admitted they usually do not verify the accuracy of the answers they receive.This lack of critical analysis reinforces the argument by Cleti & Jano (2024), who state that users often accept generated content at face value. Despite this and as we can see in annex (X) , only 16.2% of users said they had stopped using generative engines due to incorrect answers, while the vast majority (81.7%) continued to use them. This result suggests a high tolerance for possible inaccuracies, with most users maintaining the use of these solutions despite their limitations.

5.1.3 User Results Analysis: Traditional Search Engines Usage

This section will analyze the respondents' habits of using traditional search engines. Through the selected questions, we seek to understand how often these engines continue to be used, which are the most popular, and what are the main reasons given by those who use them less or more regularly. This analysis allows us to contextualize the current role of traditional search engines, such as Google or Bing, in the current digital landscape marked by the growing presence of generative tools.

We begin by analysing the specific traditional search engine that respondents reported using most often.

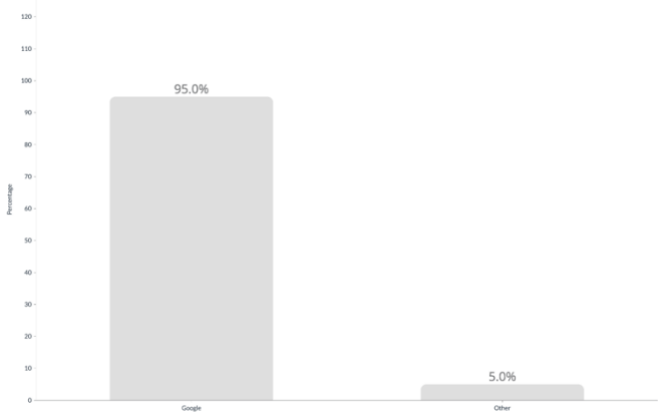

Figure 9 – Answer to the question: Which traditional search engine do you use most often?

As we can see in figure 9, most participants (94.9%) referred to Google as the most common traditional search engine while only 3% say other options are used. These results highlight that most users maintain search habits centred on Google. This is consistent with Lowe's (2024) observation that Google holds approximately 90% of the global market share and plays a dominant role in how users access information worldwide. This persistent usage may also be explained by the platform's ongoing algorithm updates over the years, aimed at continuously improving the user experience as well as the relevance and quality of the content delivered.

We also analyze how frequently users rely on search engines in their daily online routines.

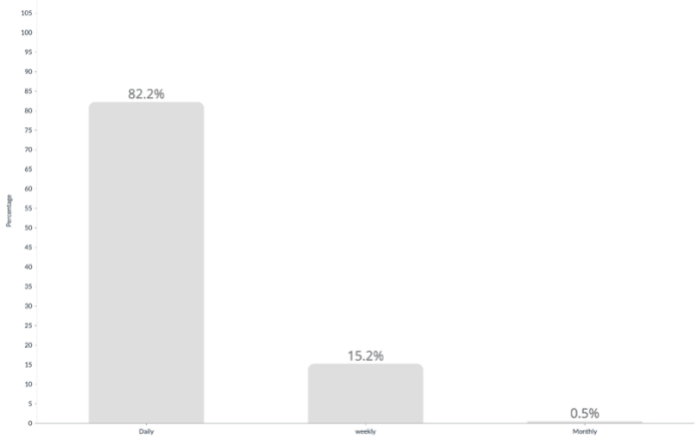

Figure 10 – Answer to the question: How often do you use traditional search engines to look for information online?

As we can see in figure 10, 82.2% of respondents use traditional search engines every day underlining their function as a gateway to online information. As Van Eijk (2009) points out, these platforms provide access to internet content. The results show that these tools remain integral to users' digital routines, consistently shaping how they search for and access information.

We also aimed to understand the reasons why the 28.9% of users prefer traditional search engines, as shown in Figure 11 below.

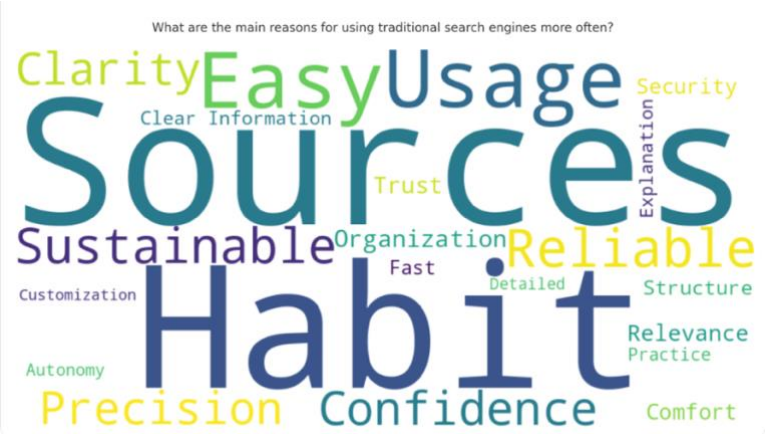

Figure 11 – Answer to the question: What are the main reasons for using traditional search engines more often?

As can be seen, based on the analysis of 57 open-ended responses, the main reasons for preferring traditional search engines are linked to habit, trust in sources, and ease of use. Respondents value knowing where and how to search, highlighting the structure of the results, and the possibility of comparing various sources.

In addition, people have concerns about accuracy and sustainability, as well as greater autonomy in the search process. Some also report distrust or discomfort with artificial intelligence-based technologies, preferring methods that offer them more control.

Finally, we aimed to gain insight into how users perceive the capacity of traditional search engines to handle complex and demanding queries, as shown in figure 12 below.

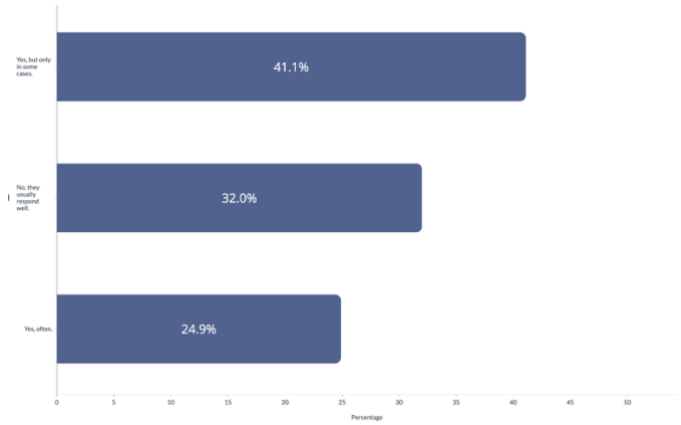

Figure 12 – Answer to the question: Do you think that traditional search engines have difficulty responding to users' more complex and demanding searches?

As we can see, of the 197 respondents, 41.1% said that traditional search engines sometimes struggle to respond to complex searches, while 24.9% stated that these difficulties occur frequently. At the same time, 32% consider that traditional search engines generally respond well, while only 2% say they never encounter any problems. These findings align with Zhou and Li's (2024) observation in the literature review, where the authors explain that the growing complexity and specificity of online searches have exposed the limitations of traditional search engines, which often fail to provide relevant and effective answers due to information overload and evolving user demands.

5.1.4 User Results Analysis: Generative Search Engine Usage Results

This section aims to explore both the frequency with which users rely on generative search engines, such as ChatGPT, and the reasons behind this preference over traditional engines like Google.

As we see before in figure 7, 44.7% of respondents use both generative and traditional search engines equally, suggesting a complementary usage. Meanwhile, 28.9% prefer traditional engines, and 24.4% (N=48) favour generative ones. To better understand the reasons behind this preference, the next figure 13, illustrates the main motivations for choosing generative search engines more often.

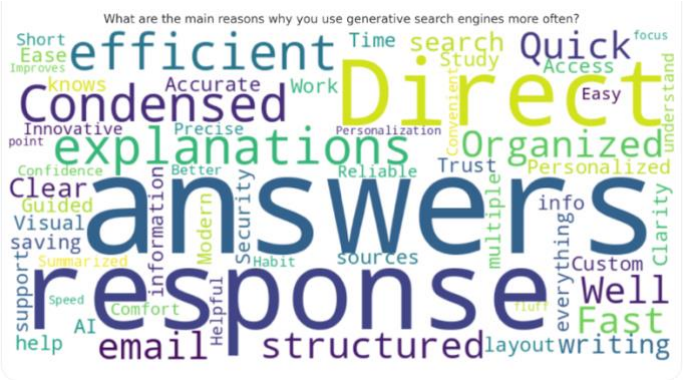

Figure 13 – Answer to the question: What are the main reasons why you use generative search engines more often?

As can be seen, to better understand the reasons behind participants' preference for generative search engines, 48 open-ended responses were analysed using qualitative content analysis and word cloud visualisation. The data shows that the main factors mentioned were speed, clarity and organisation of responses. Many respondents stated that generative search engines allow them to access condensed and structured information almost immediately, saving them time and effort when browsing through multiple sources. Expressions such as "quick response", "straight to the point" and "no beating around the bush" were common, highlighting the value placed on efficiency in the search experience.

These findings align with the transformations discussed in section 2.3.1, which argue that online information-seeking behaviour has become increasingly complex and demanding, exposing the limitations of traditional search engines, as noted by Zhou and Li (2024). The preference for generative engines, as reflected in the participants' answers, suggests that users are already recognising the added value of systems powered by large language models in addressing these evolving needs.

Additionally, the ability to personalise responses stands out. Participants mentioned that generative engines can adapt the information to their language style, instructions or intent, which corresponds to the capacity of large language models to generate contextually adapted and coherent content, as highlighted by Suri et al. (2024). The use of these engines in academic and professional contexts was also referenced, reinforcing their usefulness in clarifying doubts, confirming interpretations or saving time in repetitive tasks, a benefit made possible

by the generative architecture described by Memon and West (2024) and Aggarwal et al. (2024).

Finally, a notable level of trust in these technologies emerged from the responses. Some participants emphasised their confidence in the clarity, reliability and convenience of the outputs. This finding may be consistent with the concern raised by Cleti & Jano (2024), who assert that such trust can be indicative of an absence of critical thinking. Users may accept information at face value without questioning its accuracy, which becomes problematic when generative engines produce incorrect answers or cite unreliable sources, thus undermining their credibility.

5.1.5 User Results Analysis: Google AI Overviews User Perceptions

This section explores users' awareness of, and perceptions regarding, Google's AI Overviews , a new feature that provides generative responses directly within the search engine results. Through analysing this feature, our goal is to determine if users are familiar with it, how they view its effect on their search experience and if they continue to engage with the traditional results displayed below. This topic is particularly relevant given that AI Overviews have become one of the most visible examples of generative AI being incorporated into traditional search environments.

We begin by analysing whether users are familiar with Google AI Overviews. To help respondents understand this concept, a short explanatory video was shown before the question. Although some participants might not have recognised the term itself, those who claimed to already know it likely identified the feature based on previous interactions with Google, suggesting they had encountered it before and assumed they understood its purpose.

The figure 14 below presents, a detailed overview of the responses collected, providing insights into how users perceived and responded to the concept of Google AI Overviews after being exposed to a short explanatory video

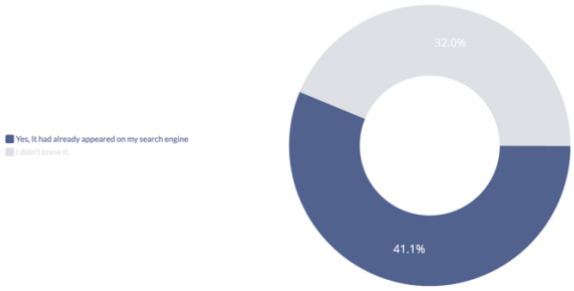

Figure 14 – Answer to the question: Did you know about Google AI Overviews before watching the video?

As can be seen in figure 14, Google AI Overviews is becoming increasingly present in the online search experience, as 60.4% of participants said they had already come across it on Google's own search engine results pages (SERPs). However, Google AI Overviews is not yet fully known. By contrast, 37.6% of respondents said they were unaware of the feature before watching the video, suggesting that despite its recent launch, some users are still unfamiliar with its presence. As Lowe (2024) affirmed, Google AI Overviews represents a significant shift in how information is processed and presented, using advanced AI models to generate direct, contextual answers. These results suggest a period of fast progress, in which AI-based solutions are quickly being integrated into users' daily search habits, while traditional methods still coexist.

As can be seen in Appendix E, of the 197 respondents, 56.9% said that Google AI Overviews improved the search experience with their speed and relevance. In contrast, 29.9% found the feature useful but noted limitations in terms of reliability and therefore utilised it more selectively. Only 6.1% showed a preference for traditional search engines, which may indicate a tendency to resist adopting new solutions.

Regarding users' clicking behaviour in the presence of Google AI Overviews, the following figure 15 provides insights into how often respondents engage with the traditional search results (links) that appear below these AI-generated summaries

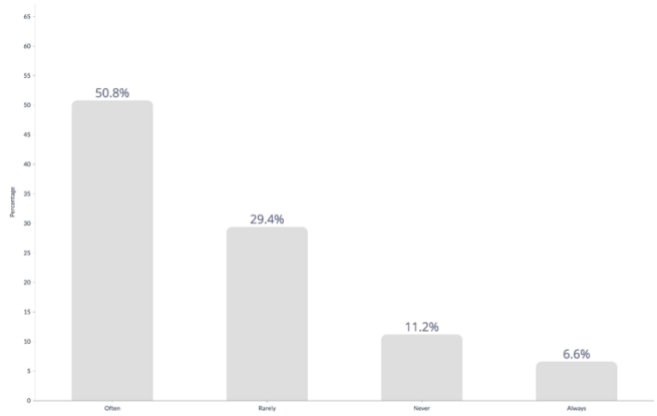

Figure 15 – Answer to the question: How often do you click on the traditional search results (links) below these AI answers?

Of the 197 participants, 50.8% said they frequently click on the traditional results (links) that appear below the Google AI Overviews on the results pages (SERP), while 29.4% do so rarely, 11.2% never click and only 6.6% said they always do so. Searching for sources through traditional links continues to be part of user behaviour, with many people seeking to validate or deepen the information presented by following the links. These findings partially validate Lowe's (2024) observation that the introduction of Google AI Overviews reduces users' need to visit external websites. While generative answers may reduce the dependency on traditional links for some users, a significant portion still engage with them regularly.

5.1.5 User Results Analysis: Users Opinions about AI Implementations

In this final section, we delve into the users' perceptions and concerns regarding the implementation of Artificial Intelligence in search engines.

As we can see in Appendix F, 54.8% of respondents tend to rely more on AI-generated answers to obtain information online, while 43.1% still regularly consult traditional websites despite having access to AI tools. Additionally, the open answers seen in Appendix G, suggest that users highlight a growing hybrid use of both generative and traditional search engines. Many participants reported using tools like ChatGPT or Google AI Overviews for their speed, clarity, and convenience, especially for simpler or everyday tasks. However, a considerable number also emphasised the importance of validating information through traditional sources,

particularly in academic contexts or when accuracy is crucial. Some users expressed concerns about the reliability and potential bias of AI-generated answers, relying on traditional engines either out of habit or due to a degree of mistrust in AI. Others pointed to a complementary use of both approaches, using AI tools as a first step and traditional engines to verify the information.

Another particularly relevant finding is that, as shown in Appendix H 54.8% of users reported having encountered incorrect or out-of-context generative responses. Nevertheless, as illustrated in Appendix I, 81.7% stated that they continue to use them.

5.2 SEO Professionals Questionary Results

This section presents an analysis of responses provided by SEO professionals. The survey was conducted between 10 May and 10 June, with a sample size of 80 professionals (N=80). As shown in the figure 16 below, the SEO professional analysis is organised into five key thematic areas, which are based on the structure of the questionnaire.

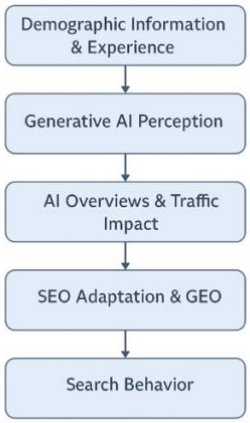

Figure 16 – Flowchart of SEO Professionals Survey Topics

This flowchart outlines the main topics that will be addressed in this section, namely Demographic Information & Experience, Generative AI Perception, AI Overviews & Traffic Impact, SEO Adaptation & GEO, and Search Behavior.

5.2.1 SEO Professionals Results Analysis: Demographics Information & Experience

This subsection begins with an examination of the demographic profile of the respondents, focusing particularly on age distribution. Additionally, we also analyse the level of professional experience of the respondents.

We begin by analysing the age distribution of SEO and Digital Marketing professionals, as illustrated in the figure 17 below.

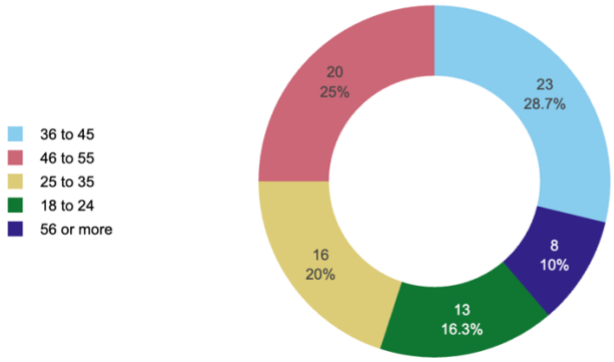

Figure 17 - SEO Professionals Age Distribution

As we can see, the chart reveals that the most represented age group is between 36 and 45 years old, representing 28.7% of the respondents. This is followed by professionals aged 46 to 55 (25%), and those aged 25 to 35 (20%). Younger participants aged 18 to 24 represent 16.3% of the sample, while only 10% are aged 56 or more. These results suggest that the majority of respondents are experienced professionals, typically between 36 and 55 years old. The smaller representation of younger professionals may indicate a later entry into the SEO field / Students, whereas the lower percentage of older participants might reflect the digital and rapidly evolving nature of this sector.

Regarding the professional experience level of our respondents, the results can be observed in the following figure 18.

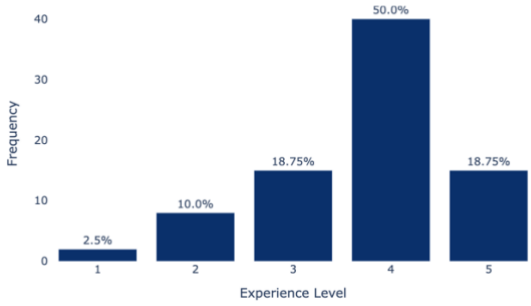

Figure 18 – Answer to the question: What is your level of experience with SEO / Digital Marketing?

As can been see, most of the professionals surveyed report a high level of experience in SEO and Digital Marketing, with 68.8% indicating levels 4 and 5. Only 12.5% reported low levels of experience. These figures suggest that the opinions collected reflect an experienced perspective on the changes introduced by generative search engines.

5.2.2 SEO Professionals Results Analysis: Generative AI Perceptions

To explore how professionals in the field of SEO and Digital Marketing view the evolving digital landscape, this section investigates their perceptions of how generative artificial intelligence is influencing user search behaviours and access to information. It also examines the implications of these technologies for SEO strategies and the visibility of online content. By doing so, this section provides valuable insight into the professional perspective on the ongoing transformation driven by generative AI.

We begin this analysis by examining how professionals perceive the transformative role of generative artificial intelligence in shaping user behaviour in online search and information access. The following figure 19 illustrates the distribution of responses regarding the perceived influence of tools such as Google AI Overviews, ChatGPT, and Perplexity on the way users interact with information online.

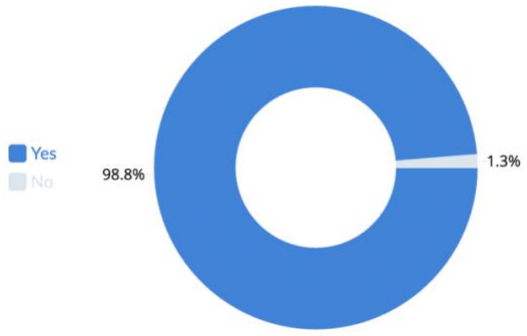

Figure 19 – Answer to the question: Do you think that Generative Artificial Intelligence (e.g., Google AI Overviews, ChatGPT, Perplexity) is transforming the way users search for and access information online?

According to the results obtained in figure 19 it was demonstrated and recognised by professionals that the way users search for and access information online is being significantly transformed by Generative Artificial Intelligence. 98.8% agreed with this statement, highlighting the fact that our search habits are changing and generative models are playing an increasingly important role in accessing digital information.

As we could see previously, most professionals acknowledge that generative AI is transforming the way users search for and interact with online information. Building on that, we wanted to understand whether this transformation also extends to the field of SEO. Specifically, we sought to explore if professionals believe that generative AI is or could be impacting SEO strategies and the visibility of online content. This is illustrated in the following figure 20 below.

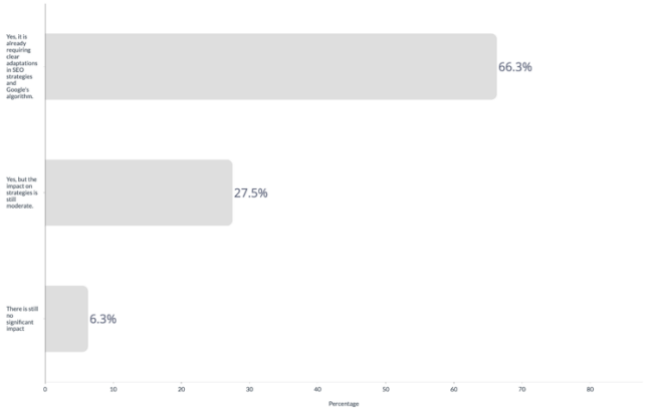

Figure 20 – Answer to the question: In your opinion, is Generative Artificial Intelligence impacting / or could it impact SEO strategies and the visibility of online content?

As can be seen in figure 20, professionals recognise that generative artificial intelligence is not just a trend, but a revolutionary technology with real and immediate effects on SEO practices. The fact that two-thirds (66.3%) recognise the need for explicit adaptations indicates that the sector must rethink its methodologies, particularly in light of evolving algorithms. This aligns with Aggarwal et al.'s (2024) perspective that the integration of generative AI into traditional search engines, such as Google with features like Google AI Overviews, is reshaping the digital landscape by introducing a new paradigm in content visibility. Traditional SEO techniques focusing on keyword optimisation and ranking in search results pages are becoming insufficient, as generative engines now synthesise information and present it in a single, AI-generated response. Consequently, professionals realise that this is not only a technical change, but also a strategic one, and that they must anticipate it to guarantee visibility in a rapidly developing digital ecosystem.

5.2.3 SEO Professionals Results Analysis: Google AI Overviews & Traffic perception

With the emergence of Google AI Overviews, significant changes have begun to take place in the way people search for and access information online. This new feature raises questions about the potential impact it may have on websites' organic traffic and on the SEO strategies currently used by professionals. In this part of the study, we analyse how SEO and digital marketing professionals perceive these changes, including whether they have observed a decrease in website visits, which types of websites may be most affected, and what the main challenges posed by these new artificial intelligence tools are for the industry.

We began by analysing whether the professionals were already familiar with the Google AI Overviews feature, as shown in the figure 21 below.

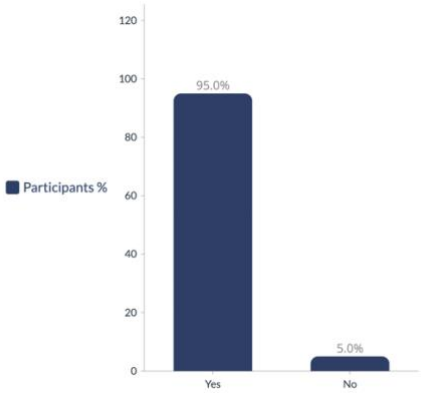

Figure 21 – Answer to the question: Before watching the video, did you already know about Google AI Overviews?

Most professionals (95%) already knew about Google AI Overviews before watching the video, which shows that they are closely monitoring the new trends influencing how people search online. This knowledge gives more weight to the professionals' opinions on the impact of artificial intelligence on SEO, showing that they speak from direct experience and not just assumptions.

Also, to complement this information, as we can see in Appendix J, most professionals (62.5%) believe that Google AI Overviews makes searching more useful for users by providing more accurate and relevant answers. This perception aligns with the findings of a literature review by Lowe (2024), who emphasises that this feature represents a positive evolution in the search experience, making it more efficient and user-centred. As the author himself mentions, this is an innovative Google strategy which aims to improve the quality and relevance of information by integrating generative artificial intelligence. However, 36.3% of professionals recognise that despite the benefits for users, there are also limitations, particularly with regard to the reliability of the answers generated.

Regarding web traffic, as we can see in the figure 22 below, we asked professionals whether, since the launch of Google AI Overviews, they have noticed a decrease in organic traffic to the websites they monitor or manage.

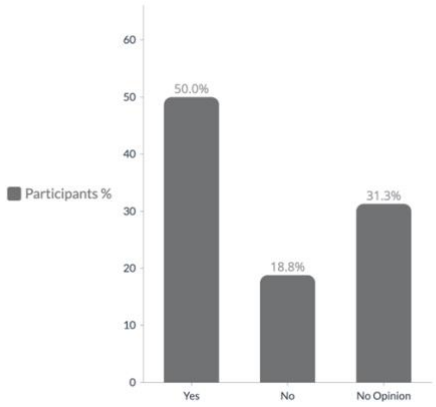

Figure 22 – Answer to the question: In your opinion, since the launch of Google AI Overviews, have you seen a decrease in organic traffic to the websites you monitor or manage?

As we can see in the results, 50% of professionals have observed a decrease in organic traffic following the implementation of Google AI Overviews. According to Lowe (2024), this can be explained by users obtaining the necessary information directly from the results page, which reduces the need to click on websites. This finding confirms what is highlighted in the literature. Meanwhile, 31.3% of respondents have not yet formed a clear opinion, possibly due to the need for more time or data to assess the impact. Additionally, 18.8% reported no change, which may be related to the nature of their content being less affected by this functionality.

To better understand the underlying reasons behind this decline in organic traffic, the following question explored professionals perceptions of its main causes. As shown in Figure 23, respondents were asked to identify the primary factors they believe are contributing to the recent drop in website visits.

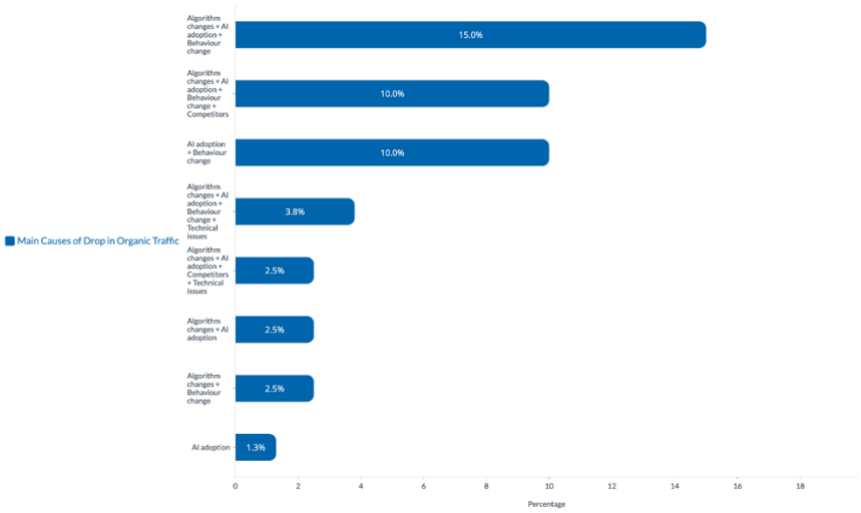

Figure 23 – Answer to the question: In your opinion, what has been the main cause of the drop in organic traffic to the websites you monitor or manage recently?

As can been seen in figure 23, indicates that approximately 15% of professionals attribute the decline in organic traffic primarily to the combination of alterations in algorithms, the integration of generative AI, and shifts in user behaviour. Following this, two combinations with 10% each were observed: changes in algorithms + AI + competition and AI + change in behaviour. These findings serve to emphasise the growing impact of AI on search engines and search habits.

To gain deeper insights and avoid limiting the responses of the professionals, we included an open-ended question that allowed them to freely express their views on the main reason for the recent decline in organic traffic. As shown in Appendix K, most professionals identified generative AI in search engines, particularly Google AI Overviews, as the main cause of this decline. They explained that these features provide users with direct answers on the search results page, which reduces the need to click on individual websites. This view is consistent with earlier findings that point to a clear link between algorithm updates, the integration of AI technologies and changes in user behaviour. Other reasons mentioned include increased market saturation, the dominance of large brands and a shift in user attention to platforms such as TikTok and Reddit. As we can see in Appendix L, 71.3% of professionals believe that organic traffic is being redirected from independent or specialised websites to larger platforms such as Reddit, Quora, Wikipedia, LinkedIn, and Instagram. This aligns with Lowe's

(2024) observations in the literature review, which highlight that recent algorithm updates and the introduction of Google AI Overviews have increased the visibility of platforms offering reliable, regularly updated, user-generated content. Reddit and Quora, for example, benefit from strong community engagement and broad topical coverage, while Wikipedia is renowned for its credibility and organised information. The relatively small percentage of respondents who noticed no change (17.5%) and those who were uncertain (11.3%) further support the idea that this shift in traffic is widely recognised within the SEO and digital marketing fields.

Another aspect analysed was the relationship between traditional link clicks and users obtaining answers directly on the results page through Google AI Overviews. The aim was to evaluate whether this integration has led to a reduction in clicks to websites from the professionals' perspective, or if it has had no significant impact. As shown in the figure 24 below, the results were as expected and align with previous discussions in the literature review.

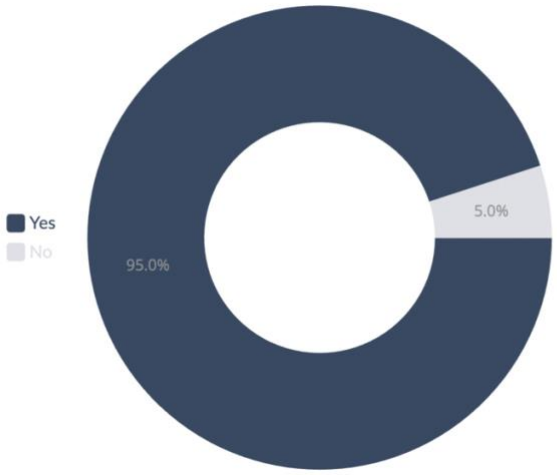

Figure 24 – Answer to the question: "With the introduction of Google AI Overviews at the top of Google search results, users feel less and less need to go to websites as they can find the information they need directly on the results page. This significantly reduces the click-through rate on traditional links, especially affecting content creators and website owners who rely heavily on organic traffic." Do you agree with this statement?

As can been seen, around 95 percent of professionals believe that the introduction of Google AI Overviews at the top of search results means users do not need to access websites as directly as before. This reinforces the conclusion that providing answers directly on the SERP (Search Engine Results Page) means fewer clicks on organic results. The traditional role of websites as the final destination of a search is becoming less significant. This question was based on a statement from Lowe (2024), included in the literature review, which we sought to validate through the survey. The strong agreement from professionals confirms that this concern is widely shared and highlights an increasing challenge for SEO professionals, who must now adapt their strategies in a world where clicks are no longer guaranteed.

Furthermore, as we can see in Appendix M, regarding the frequency with which users click on traditional organic search results that appear below AI-generated overviews, most SEO professionals indicated that this happens “rarely” or only “sometimes.” These responses suggest a clear trend of declining organic traffic, even for websites that are well positioned in the SERPs, reflecting a growing user tendency to engage primarily with AI-generated summaries rather than navigating to external pages.

To complement the previous insights, the objective was to gain a more detailed understanding, from the professionals’ perspective, of which types of websites are perceived to be most affected by the implementation of Google AI Overviews. The focus was on determining whether larger, well-established websites or smaller, less prominent ones are more vulnerable to potential declines in traffic caused by this development

As we can see in Appendix N, the questionnaire results suggest that 58.8% of professionals think the websites most impacted by Google's AI Overviews changes are those heavily reliant on organic traffic, e.g., blogs and small business sites. This corroborates the findings of Lowe (2024) in the literature review, which states that small websites are particularly vulnerable to these changes due to their heavy reliance on organic clicks. Lowe also points out that Google AI Overviews prioritise larger, more authoritative sources, which makes it harder for smaller sites to gain visibility and traffic.

These survey results reinforce this concern, as professionals largely agree that the shift towards AI-generated summaries directly impacts the visibility of small websites. However, it

is worth noting that 28.8% of respondents believe that the impact could affect large and small websites similarly. While this suggests that the paradigm shift may challenge websites of all sizes, larger websites typically have more resources with which to adapt to the evolving digital environment.

To better understand the perspective of SEO professionals, we examined their views on the impact of Google AI Overviews on their daily work. As we can see in Appendix O, of those surveyed, 92.5% believe that this new reality will make their work more challenging. This supports the argument in the literature review by Lowe (2024), which states that, although Google AI Overviews aim to enhance the user experience by providing more accurate and immediate answers, they also raise concerns among content creators and marketing professionals due to their potential impact on web traffic, content creation and the overall structure of the internet.

The responses show that professionals recognise the need to adapt their strategies, particularly given that users are increasingly obtaining answers directly on the search page. Only a small percentage (7.5%) believe that these changes will not significantly affect their tasks or projects.

To gather deeper insights, we included an open-ended question to give participants the freedom to express their perspectives without limitations regarding what they consider to be the main challenges since the integration of Google AI Overviews. As shown in the figure 25 below, the responses were particularly interesting and insightful.

Figure 25 – Answer to the question: In your opinion, what are the main challenges and impacts that the integration of Google AI Overviews could bring to SEO professionals and the online search ecosystem?

As can be seen, the analysis of the 74 responses reveals that professionals are particularly focused on understanding how to maintain or improve the visibility of their sites in the new context through Google AI Overviews. The word information comes up a lot, which shows that there is still a lot of uncertainty and lack of clarity about how this new reality works. Terms such as optimization, authority, click, diversify, and visibility reinforce that the main challenges are directly linked to adjusting strategies to maintain a presence in search and on the results page, minimizing the loss of traffic, and understanding how content can be highlighted in the responses generated by AI Overviews.

5.2.3 SEO Professionals Results Analysis: SEO Adaptation & GEO

In this section, our aim was to understand how SEO and digital marketing professionals are adapting to ongoing changes in search engines, particularly in light of the increasing use of artificial intelligence and the development of generative search engines. Using the survey questions as a basis, we explores the impact of the shift towards generative search and the continued relevance of traditional SEO techniques in this evolving context. We also assessed participants' familiarity with Generative Engine Optimisation (GEO) and whether they consider it an effective way to boost the visibility of online content. This analysis provides insights into professionals' awareness of the need to evolve and the emerging strategies already being adopted.

With the ongoing digital paradigm shift, particularly marked by the emergence of generative search engines and the integration of Google AI Overviews into the Google search engine, we aimed to better understand professionals’ perspectives on whether traditional SEO methods apply directly to these new engines. Specifically, we explored their views on how these engines require new approaches to increase visibility in their responses, as demonstrated in the figure 26 below.

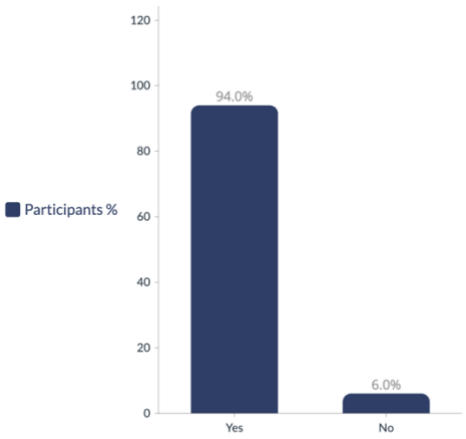

Figure 26 – Answer to the question: “Traditional SEO methods do not apply directly to generative search engines, which require new approaches to increase visibility in their responses.” Do you agree with this statement?

As we can see, most of professionals 94% recognize that traditional SEO no longer fully applies to search engines with generative AI, such as Google AI Overviews. This confirms what the authors describe in the literature since search engines have changed and no longer rely solely on keywords and links. Moreover, information is now also presented in AI-generated responses (Google AI Overviews), which combine content/sources from various sites and then compile it into a conversational response for the user who carried out the search. As a result, visibility no longer depends on "just" being well positioned on the results page (SERP) or in matching keywords but also on being quoted in AI responses.

In order to better understand the 6% of the figure 26, we decided to analyze better the perspectives of those who still think that traditional SEO is fully applicable to search engines with generative AI, such as Google AI Overviews.

Figure 27 – Answer to the question: Why don't you agree with this statement?

As we can see in figure 27, the answers reveal that the fundamental principles of SEO are still valid for these professionals. They believe that practices such as on-page SEO, a focus on user experience, and brand EEAT remain essential, regardless of technological changes. In this group's view, what is changing is not the essence of SEO but the metrics and how success is measured.

Next, we set out to explore the concept of Generative Engine Optimisation with professionals in the field. As this is a relatively new concept, we assessed their familiarity with it and understanding of its purpose, as shown in Figure 28 below.

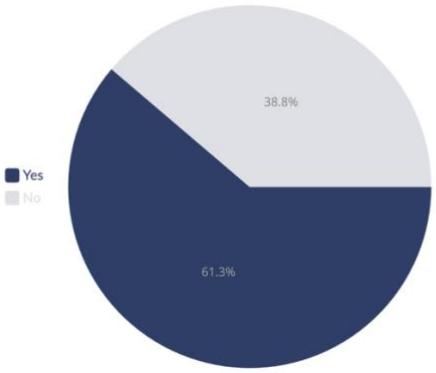

Figure 28 – Answer to the question: Is the concept of Generative Engine Optimization (GEO) familiar to you?

As can been seen, 61.3% of respondents already understand the concept of Generative Engine Optimization (GEO), while 38.8% say they have not yet encountered this term. This result

indicates that, although it is a relatively recent concept in the context of search engines with generative artificial intelligence, a significant proportion of professionals already have some knowledge of the subject. However, the fact that almost 40% are still unfamiliar with GEO shows that the market is clearly in a phase of transition and adaptation.

To complement this information, we also asked professionals whether they currently consider Generative Engine Optimization (GEO) to be a relevant and differentiating factor in boosting the visibility of online content, as shown in Appendix P. Approximately 41.3% of respondents already view GEO as a key factor in enhancing online visibility. Although the concept is still emerging, this percentage indicates that it is beginning to gain traction in the market. Conversely, 38.8% stated they did not know, and 18.8% believed it is still too early to evaluate. These results suggest that the industry is in a transitional phase, with some uncertainty surrounding the practical implementation of GEO. Nonetheless, there is a clear trend towards recognizing this new paradigm as increasingly essential, especially as AI-powered search engines continue to evolve.

In light of the preceding data, the objective was to ascertain whether individuals acquainted with the innovative concept were also implementing optimisation techniques in their practices, as depicted in the subsequent figure. In order to assess whether our professional participants had already incorporated the techniques mentioned by academic authors into their work or ongoing projects, we included several such techniques in our questionnaire.

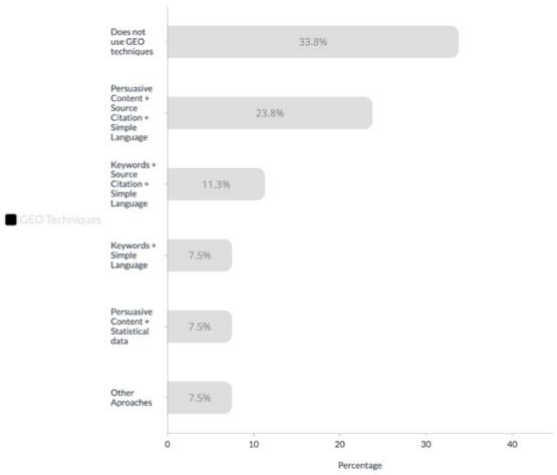

Figure 29 – Answer to the question: Have you ever used these Generative Engine Optimization (GEO) techniques in your work?

As can be seen in figure 29, the 49 professionals who said they were familiar with the Generative Engine Optimization GEO concept. Despite this knowledge, 33.8 percent admit that they do not use any techniques yet, which shows that practical application is still at an early stage. On the other hand, 23.8 percent have already implemented combined strategies such as persuasive content, citation of sources, and simple language, reinforcing the credibility and clarity of content in the eyes of artificial intelligence search engines. The rest of the respondents are divided into combinations such as keywords associated with plain language 7.5 percent or statistical data 7.5 percent, in addition to 11.3 percent who use keywords citing sources and plain language together. These results show that even among those who know GEO, adoption is still uneven. Most are experimenting with different approaches, reflecting a transition market where there are still no fully consolidated practices.

5.2.3 SEO Professionals Results Analysis: Professionals Search Behavior

This section aims to analyse the search behaviour of professionals as internet users. Just like general users, professionals also have their own search habits and preferences when seeking information online. The analysis explores the frequency with which traditional search engines are still being used, the specific platforms that are most commonly accessed, and the reasons behind professionals' continued reliance on these tools or, conversely, their shift towards generative search engines such as ChatGPT, Perplexity, or Google AI Overviews. Additionally, it assesses professionals' perceptions regarding the limitations of traditional search engines in handling more complex queries, as well as the potential risks associated with the use of generative engines, particularly concerning the possibility of inaccurate or misleading results, commonly referred to as hallucinations.

As we can see in Appendix Q, most professionals regularly use traditional search engines like Google, Bing, or Yahoo to search for information online. 97.5 percent of respondents indicated that they use them frequently, while only 2.5 percent reported that they do not. Among those who regularly use traditional search engines, Google was identified as their first choice, as shown in Appendix R. This result confirms that, despite the rise of AI-based search engines, traditional engines continue to play a fundamental role in users' digital routines. Regarding usage, the majority of professionals use traditional search engines daily to obtain information online, representing 96.3 percent (77 people) of the sample. Only 1.3 percent (1 person) said

they use these engines weekly, and 2.5 percent (2 people) said they do not use them regularly. For professionals and brands, ensuring a strong and optimized presence on Google engines remains essential, as they are directly linked to users' daily information-seeking behaviour, as we can see in Appendix S.

Concerning the use of generative search engines, as shown in Appendix T, all the professionals surveyed use generative search engines like ChatGPT to look for information online. These generative AI tools are no longer just used to retrieve information. They now play an active role in supporting the execution of more complex and intellectually demanding tasks, as they can generate clear, original content. Suri et al. (2024) support this idea in their literature review, explaining that generative search engines go beyond traditional keyword-based searches by using Large Language Models to produce coherent and meaningful responses. Regarding the frequency of their use, as we can observe in Appendix U, 96.3 percent (77 people) use them daily, while the remaining 3.8 percent (3 people) use them weekly. This result confirms that generative engines are a regular option and a work tool fully integrated into everyday professional life.

Additionally, we wanted to understand which type of search engine professionals use more frequently, whether traditional or generative, as shown in the following figure 30 below.

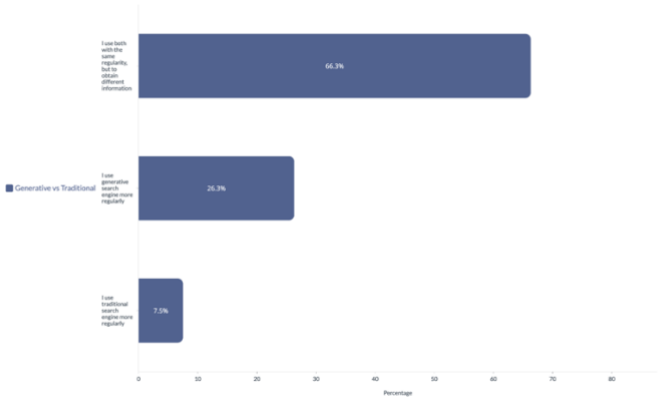

Figure 30 – Answer to the question: These days, do you use generative search engines (e.g., ChatGPT) more often than traditional search engines (e.g., Google) to find information online?

As can be seen, most professionals (66.3%) currently use traditional and generative search engines with the same frequency but for different needs, demonstrating that these tools complement each other daily. However, the fact that 26.3% already use generative engines such as ChatGPT more regularly shows a growing trend that could, in the future, lead to a greater affirmation of these engines as the primary source of research, especially as they become more accurate, efficient, and integrated into professionals' workflows. In contrast, only 7.5% of respondents stated that they still rely more heavily on traditional search engines, which may reflect a preference for established methods or a lack of familiarity with generative tools.

We really wanted to do a more detailed analysis and better understand the reasons behind the answers. The following figure 31 shows the reasons and preferences behind the use of generative search engines compared to traditional ones.

Figure 31 – Answer to the question: Why do you regularly prefer generative search engines over traditional ones?

As can be seen the preference for generative search engines is closely linked to the need to save time and get answers quickly. Words such as fast, time, response, and less search come up constantly, reinforcing that these engines are chosen above all for their agility in delivering information. Professionals especially value the way information is presented in a clear, direct, and summarized way. Instead of navigating through several pages and sources, as is the case with traditional engines, the answer is already compiled and contextualized, making the process much more efficient. The conversational format is also much appreciated. They can delve deeper into topics and clarify doubts more naturally than when talking to a colleague at

work. These tools are increasingly seen as a support in their daily tasks, whether searching for information, creating content, or validating ideas. Although some acknowledge that sometimes it is necessary to confirm certain information, the general perception is quite clear as generative engines offer a more practical, faster and more productive experience.

Additionally, many professionals, as we can observe in Appendix V, believe that traditional search engines face difficulties in responding to more complex and demanding user queries.The majority of professionals surveyed believe that traditional search engines such as Google struggle to provide satisfactory results for more complicated or demanding searches. More than half (55%) say this happens often, while 37.5% believe it depends on the topic. Only a small proportion (6.3%) consider that traditional search engines are always able to respond effectively to complex and difficult queries.

This difficulty is consistent with findings in the academic literature (Zhou & Li, 2024), which highlight the limitations of traditional search engines when faced with increasingly complex and specific online information needs. These limitations have paved the way for new approaches powered by generative artificial intelligence. Unlike conventional engines, which retrieve static information, generative models based on large language models (LLMs) can produce coherent and contextualised answers tailored to user intent (Suri et al., 2024; Memon & West, 2024).

This may help explain why many professionals are increasingly turning to generative search engines such as ChatGPT. These tools are perceived as more effective in providing complete, clear and detailed responses in a conversational tone, especially when the topic requires deeper understanding and the synthesis of information from multiple sources (Aggarwal et al., 2024).

Moreover, we also concluded from the data collected, as shown in Appendix W, that around 83.8 percent of professionals believe they currently have a greater tendency to obtain information through generative search engines such as Google AI Overviews or ChatGPT rather than by directly consulting traditional information websites. On the other hand, 15 percent stated that, despite the possibility of accessing information through artificial

intelligence, they still regularly visit websites to stay informed or obtain more detailed content. This means that, even while recognising the implications of tools like Google AI Overviews in reducing website clicks, these professionals have also adapted to new search habits from a user perspective.

On the other hand, regarding traditional search engines, as we can observe in the following figure 32, the results were also particularly interesting.

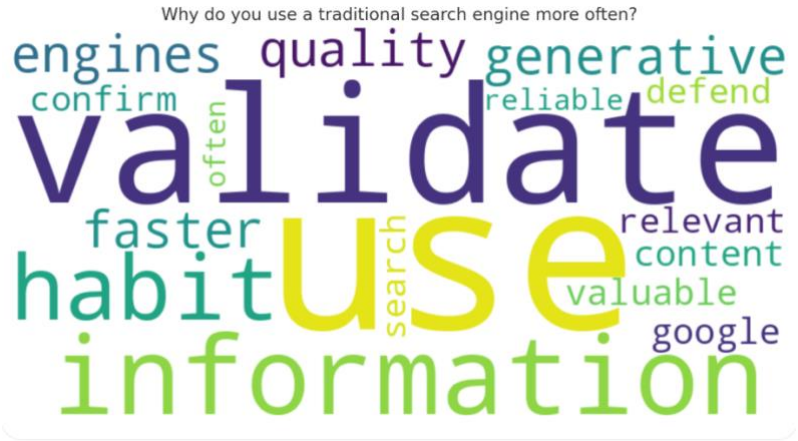

Figure 32 – Answer to the question: Why do you use a traditional search engine more often?

As we can see in figure 32, when looking specifically at the reasons why the small group of professionals (7.5%) still use traditional search engines more regularly, the primary motivations are linked to habit, trust, and validation of information. Some participants mention that traditional engines, notably Google, are still perceived as offering more reliable and higher-quality information, especially when validating facts. Others highlight that they feel more comfortable and familiar with traditional search processes. At the same time, generative engines are often used for speed and quick answers but complement traditional searches when accuracy is essential.

Finally, we provided professionals with the option to share any final comments through an open-ended response before concluding the questionnaire. Although the number of responses was limited, as shown in Appendix X, professionals acknowledged that we are currently experiencing a significant transformation in the digital ecosystem, driven by the adoption of generative search engines. They highlighted the growing urgency for companies,

especially those that rely on organic traffic, to adapt their strategies by shifting from traditional SEO to GEO (Generative Engine Optimisation) practices in order to maintain visibility within an ever-evolving search environment. Additionally, platforms like TikTok are becoming increasingly relevant as alternative search tools, particularly among younger users, which could further reshape information consumption habits in the near future. Lastly, there is concern about the implications of this shift for smaller websites, which may face greater challenges in maintaining traffic and competitiveness, as they lack the same resources as larger players to adapt to this new digital reality.

5. CONCLUSIONS

This research aimed to understand the impact of the transition from traditional search engines to generative search engines, such as Google AI Overviews, on SEO strategies and the visibility of online content. Its specific objectives are to 1) understand how the transition from traditional to generative search engines is impacting the SEO strategies adopted by marketing professionals and SEO specialists, 2) to assess the impact on organic website visibility and generated traffic, 3) to explore perceptions regarding the credibility and effectiveness of AI-generated responses and generative search engines, and finally, 4) to understand user behavior in the online search process.

By addressing these objectives collectively, we arrive at the final conclusion regarding the research question, which aims to understand the impact of the transition from traditional search engines to generative search engines such as Google AI Overviews on SEO strategies and the visibility of online content. To ensure a more structured conclusion, the findings will be presented individually for each specific objective previously formulated in this study.

1) Understand how the transition from traditional to generative search engines is impacting the SEO strategies adopted by marketing professionals and SEO specialists

The research revealed that most SEO professionals acknowledge that traditional methods are no longer fully effective in an environment dominated by AI-generated responses. Despite a general awareness of the concept of Generative Engine Optimization (GEO), many professionals admitted they have not yet implemented such techniques in practice. Although there is a growing recognition of the need to restructure content for citation in AI summaries, a clear gap remains between conceptual understanding and actual execution. This highlights a disconnect between the perceived need for change and the practical implementation of new strategies, reflecting a broader misalignment between emerging academic theory and current market practice. While the literature, particularly Aggarwal et al. (2024), proposes concrete approaches for optimization in generative environments such as new visibility metrics and structured content principles, the real-world application of these strategies is still limited. It is

therefore concluded that this transition compels professionals to rethink their strategies based on semantics, information structure and source credibility, moving beyond traditional keyword-based SEO techniques.

2) Impact on Organic Website Visibility and Generated Traffic

The empirical data gathered from SEO professionals confirms a consistent trend of declining organic traffic since the emergence of generative search engines and the incorporation of Google AI Overviews into the Google search engine. A significant portion of SEO professionals reported a direct decrease in the number of visits to the websites they manage or monitor, attributing this decline to the increasing prevalence of AI-generated responses appearing at the top of search engine results pages. This perception supports the warnings in the literature, such as those from Lowe (2024) and Burton (2025), who point to the rapid rise of zero-click searches, where users obtain the desired information directly from the SERP without the need to click on any link. The data also reveals that even when websites maintain strong positions in traditional organic search results, this visibility no longer automatically translates into traffic, as users are increasingly engaging with AI-generated summaries which indicates a significant shift in user search behavior following this new digital paradigm.

3) Perceptions Regarding the Credibility and Effectiveness of AI-Generated Responses and Generative Search Engines

Based on the questionnaire data and the theoretical foundations, it can be concluded that participants acknowledge the usefulness of AI-generated responses but remain aware of their limitations. Several respondents reported having encountered incorrect or out-of-context answers, reflecting concerns about the risk of hallucinations in generative models, as discussed by Cleti and Jano (2024). Nevertheless, the vast majority stated that they continue to use these tools due to factors such as speed, efficiency, and convenience. The findings also indicate that participants currently use both traditional search engines and generative search engines, but for different purposes. This suggests that there is not yet a complete shift toward exclusive reliance on generative search and that users remain in a phase of transition and adaptation to this new paradigm.

4) User Behavior in the Online Search Process

It can be concluded that since the emergence of generative search engines and the resulting need for major platforms like Google to adapt in order to remain relevant and competitive in the market, as noted by Memon and West (2024), the introduction of Google AI Overviews has significantly impacted the way users search for information. At the same time, it became evident that SEO professionals recognize the challenge posed by the increasing prevalence of zero-click searches. The fact that many users admitted to clicking less on traditional links because the AI Overviews already meet their informational needs highlights a shift in user behavior and reinforces the urgency for professionals to adjust their digital strategies. Brands and websites that remain heavily dependent on traffic acquisition through traditional search methods may face substantial decreases in visibility and user engagement. Moreover, the findings support the trend described by Lowe (2024), which suggests that the growing popularity of platforms such as Reddit and Quora is driven by users' preference for authentic, user-generated content over highly produced commercial material. These platforms are seen as more trustworthy sources that cover a wide range of topics with detailed and timely responses, aligning with Google's expectations regarding content quality and relevance.

Global Conclusion: How is the impact of the transition from traditional search engines to generative search engines such as Google AI Overviews on SEO strategies and the visibility of online content?

The transition is changing both SEO practices and user behavior. SEO professionals are starting to move beyond traditional keyword strategies because AI-generated summaries now appear at the top of search results. While most professionals know about Generative Engine Optimization (GEO), few are applying it. At the same time, users are clicking less on traditional links because the AI responses already answer their questions. This shift in behavior means that good rankings no longer guarantee traffic, and SEO strategies must now focus on being included in AI summaries.

Limitations

One of the main limitations of this research lies in the novelty of the topic. As the shift from traditional to generative search engines is still unfolding, it was particularly challenging to find consolidated academic literature and authors with contrasting perspectives. In several theoretical sections, the scarcity of sources led to a repeated reliance on the same authors, such as Lowe (2024), which may have limited the critical depth of the discussion.

Additionally, the study did not include inferential statistical analysis. Although the collected data would allow for the exploration of variable correlations and more complex statistical interpretations, a decision was made to maintain a descriptive approach to ensure clarity and focus. While this approach aligns with the exploratory nature of the research, it is acknowledged that a deeper statistical treatment could have added further analytical value and robustness to the findings.

Future Research

Based on the limitations of the study, some directions for future research are suggested. First, it would be useful to:

1. apply inferential statistical methods to better understand the relationships between variables, such as the perceived impact of AI and the use of GEO techniques.
2. Secondly, it is recommended to expand the sample to different countries, age groups, and industries, in order to obtain more representative results.
3. It would also be interesting to complement this study with interviews with professionals in SEO, marketing, and artificial intelligence, to gather more detailed and in-depth opinions.
4. Finally, future research could analyse how the position and size of citations in AI-generated responses influence the actual traffic of websites, helping to better understand the relationship between visibility and performance.

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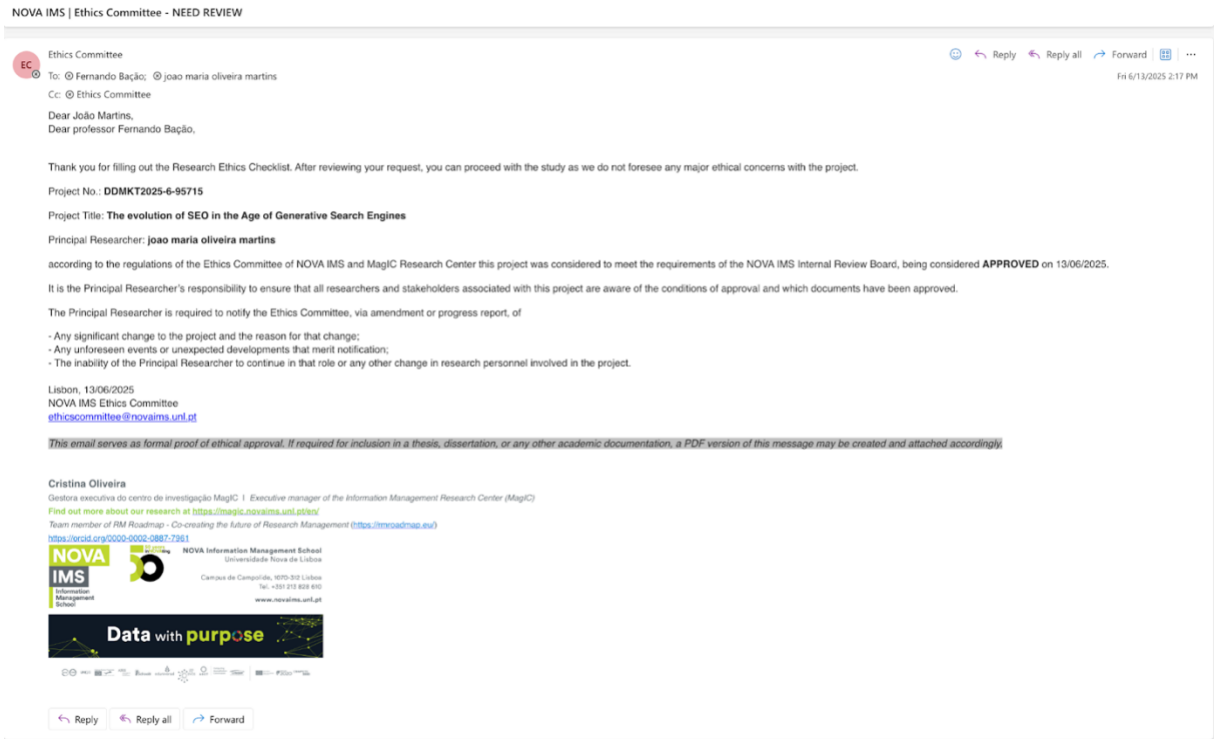
APPENDIXES

Appendix A - Approval of Nova IMS Ethics Committe



NOVA IMS | Ethics Committee - NEED REVIEW

Ethics Committee

To: Fernando Bação; joao maria oliveira martins

Cc: Ethics Committee

Reply Reply all Forward

Fri 6/13/2025 2:17 PM

Dear João Martins,
Dear professor Fernando Bação,

Thank you for filling out the Research Ethics Checklist. After reviewing your request, you can proceed with the study as we do not foresee any major ethical concerns with the project.

Project No.: **DDMKT2025-6-95715**

Project Title: **The evolution of SEO in the Age of Generative Search Engines**

Principal Researcher: **joao maria oliveira martins**

according to the regulations of the Ethics Committee of NOVA IMS and MagIC Research Center this project was considered to meet the requirements of the NOVA IMS Internal Review Board, being considered **APPROVED** on 13/06/2025.

It is the Principal Researcher's responsibility to ensure that all researchers and stakeholders associated with this project are aware of the conditions of approval and which documents have been approved.

The Principal Researcher is required to notify the Ethics Committee, via amendment or progress report, of

- Any significant change to the project and the reason for that change;
- Any unforeseen events or unexpected developments that merit notification;
- The inability of the Principal Researcher to continue in that role or any other change in research personnel involved in the project.

Lisbon, 13/06/2025
NOVA IMS Ethics Committee
ethicscommittee@novaims.unl.pt

This email serves as formal proof of ethical approval. If required for inclusion in a thesis, dissertation, or any other academic documentation, a PDF version of this message may be created and attached accordingly.

Cristina Oliveira
Gestora executiva do centro de investigação MagIC | *Executive manager of the Information Management Research Center (MagIC)*
Find out more about our research at https://magic.novaims.unl.pt/en/
Team member of RM Roadmap - Co-creating the future of Research Management (https://rmroadmap.eu/)
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Data with purpose

Reply Reply all Forward

Appendix B Survey - SEO professionals Questions path

Question No.	Question
1	Age
2	What is your profession?
3	How much experience do you have with SEO / Digital Marketing?
4	Do you think that Generative Artificial Intelligence (e.g. Google AI Overviews, ChatGPT, Perplexity) is transforming the way users search for and access information online?
5	In your opinion, is Generative Artificial Intelligence impacting / or could it impact SEO strategies and the visibility of online content?
6	Before watching the video, did you already know about Google AI Overviews?
7	Based on the previous video, do you think that the introduction of AI Overviews on Google represents an improvement in the user experience during the search process?

8	In your opinion, since the launch of Google AI Overviews, have you seen a decrease in organic traffic to the websites you monitor or manage?
9	When you indicated that there has been a drop in organic traffic, can you share how you detected this variation?
10	In your opinion, what has been the main cause of the drop in organic traffic to the website you monitor or manage recently?
11	Please indicate what you think is the main cause of the drop in organic traffic to the websites you monitor or manage?
12	To what extent have these changes impacted your key performance indicators?
13	Has the drop in organic traffic significantly affected your results?
14	With the introduction of Google AI Overviews at the top of Google's search results, users feel less and less need to go to websites, as they can find the information they need in the search results.
15	Do you think Google is reducing its dependence on link clicks to provide answers to users?
16	And what kind of websites do you think could be most harmed by the introduction of Google AI Overviews?
17	Do you think that incorporating Google AI Overviews into the search engine will be more challenging for SEO professionals?
18	Why do you think the introduction of Google AI Overviews will not challenge SEO professionals?
29	In your opinion, what are the main challenges and impacts that the integration of Google AI Overviews could bring to SEO professionals and the online search ecosystem?
20	Do you think it's important to adapt to changes in Google's search engine algorithms?
21	Traditional SEO methods are not directly applicable to generative search engines, which require new approaches to increase visibility in their responses. Do you agree with this statement?
22	Why don't you agree with this statement?
23	In your opinion, what type of websites will benefit most from the introduction of Google AI Overviews?
24	Are you familiar with the concept of Generative Engine Optimization (GEO)?
25	In your opinion, is Generative Engine Optimization (GEO) already a relevant and differentiating factor in boosting the visibility of online content?
26	Have you ever used Generative Engine Optimization (GEO) techniques in your work?

27	From your perspective, do you think that organic traffic is being redistributed to platforms such as Reddit, Quora, Wikipedia, LinkedIn or Instagram, to the detriment of independent or specialized sites?
28	Do you regularly use traditional search engines (such as Google, Bing, Yahoo, among others) to look for information online?
29	When you don't use traditional search engines, what alternative means do you use to access information online?
30	Which traditional search engine do you use most regularly?
31	How often do you use traditional search engines to obtain information online?
32	Why do you rarely use traditional search engines?
33	Have you ever used generative search engines, such as ChatGPT, to look for information online?
35	How often do you use generative search engines?
36	Why do you use generative search engines infrequently?
37	Nowadays, do you more often use generative search engines (e.g. ChatGPT) rather than traditional search engines (such as Google) to look for information online?
38	Why do you use a traditional search engine more often?
39	What makes you prefer generative search engines to traditional ones on a more regular basis?
40	Do you think that traditional search engines have difficulty responding to more complex and demanding searches by users?
41	Have you seen inaccurate or decontextualized answers generated by generative search engines such as Google AI Overviews / ChatGPT / Perplexity?
42	In your opinion, generative search engines such as Google AI Overviews, ChatGPT or Perplexity may pose a risk due to the possibility of providing wrong or inaccurate answers
43	In your opinion, the increasing use of answers generated by artificial intelligence (such as Google AI Overviews or ChatGPT) has reduced your need to consult traditional information websites.
44	Would you like to add any comments about your experience with traditional and generative search engines?
45	Please share with us your observations, experiences or opinions on the use of traditional and generative search engines.
46	Do you believe that Generative Artificial Intelligence is transforming the way people search for and access information online?
47	Do you often use search engines such as Google or ChatGPT to look for information on the internet?

48	When you don't use traditional search engines, what alternative means do you use to access information online?
49	Which of the traditional search engines do you use most often?
50	How often do you use traditional search engines to look for information online?
51	Why do you infrequently use traditional search engines to look for information online?
52	Have you ever used a generative search engine, such as ChatGPT, Gemini or Perplexity AI?
53	Which generative search engine do you use most often?
54	How often do you use generative search engines to look for information online?
55	Do you currently use generative search engines (such as ChatGPT) more often than traditional search engines (such as Google) to access information online?
56	What are the main reasons why you use generative search engines more often?
57	Why do you rarely use generative search engines?
58	What are your main reasons for using traditional search engines more often?
59	Do you think that traditional search engines have difficulty responding to users' more complex and demanding searches?
60	Please watch the first 30 seconds of the video below carefully. The video lasts approximately 2 minutes and briefly introduces Google AI Overviews.
61	Before watching the video, did you already know about Google AI Overviews?
62	Based on the previous video, do you think that the introduction of AI Overviews on Google represents an improvement in the user experience when searching?
63	How often do you click on the traditional search results (links) below these AI answers?
64	Do you think that generative search engines, such as Google AI Overviews, ChatGPT or Perplexity, could pose risks by providing inaccurate or incorrect answers (“hallucinations”)?
65	Have you ever seen incorrect or out-of-context answers generated by generative search engines such as Google AI Overviews, ChatGPT or Perplexity?
66	Have you ever stopped using a generative search engine because of incorrect answers?
67	In your opinion, the increasing use of answers generated by artificial intelligence (such as Google AI Overviews or ChatGPT) has reduced your need to consult traditional information websites.

68	Would you like to add any comments about your experience with traditional and generative search engines?
69	Please share with us your observations, experiences or opinions on the use of traditional and generative search engines.

Appendix C - Survey - General Users Questions path

Question No.	Question
1	Age
2	What is your profession?
3	Do you believe that Generative Artificial Intelligence is transforming the way people search for and access information online?
4	Do you often use search engines such as Google or ChatGPT to look for information on the internet?
5	When you don't use traditional search engines, what alternative means do you use to access information online?
6	Which of the traditional search engines do you use most often?
7	How often do you use traditional search engines to look for information online?
8	Why do you infrequently use traditional search engines to look for information online?
9	Have you ever used a generative search engine, such as ChatGPT, Gemini or Perplexity AI?
10	Which generative search engine do you use most often?
11	How often do you use generative search engines to look for information online?
12	Do you currently use generative search engines (such as ChatGPT) more often than traditional search engines (such as Google) to access information online?
13	What are the main reasons why you use generative search engines more often?
14	Why do you rarely use generative search engines?
15	What are your main reasons for using traditional search engines more often?
16	Do you think that traditional search engines have difficulty responding to users' more complex and demanding searches?
17	Before watching the video, did you already know about Google AI Overviews?
18	Based on the previous video, do you think that the introduction of AI Overviews on Google represents an improvement in the user experience when searching?
19	How often do you click on the traditional search results (links) below these AI answers?

20	Do you think that generative search engines, such as Google AI Overviews, ChatGPT or Perplexity, could pose risks by providing inaccurate or incorrect answers (“hallucinations”)?
21	Have you ever seen incorrect or out-of-context answers generated by generative search engines such as Google AI Overviews, ChatGPT or Perplexity?
22	Have you ever stopped using a generative search engine because of incorrect answers?
23	In your opinion, the increasing use of answers generated by artificial intelligence (such as Google AI Overviews or ChatGPT) has reduced your need to consult traditional information websites.
24	Would you like to add any comments about your experience with traditional and generative search engines?
25	Please share with us your observations, experiences or opinions on the use of traditional and generative search engines.

Appendix D - Answer to the question: Have you ever seen incorrect or out-of-context answers generated by generative search engines such as Google AI Overviews, ChatGPT or Perplexity?

Have you ever seen incorrect or out-of-context answers generated by generative search engines such as Google AI Overviews, ChatGPT or Perplexity?

		Frequency	Percentage	Valid percentage	Cumulative percentage
Valid		4	2,0	2,0	2,0
	I don't usually check.	24	12,2	12,2	14,2
	No.	61	31,0	31,0	45,2
	Yes.	108	54,8	54,8	100,0
	Total	197	100,0	100,0	

Appendix E - Answer to the question: According to the previous video, do you think that the introduction of AI Overviews on Google represents an improvement in the user experience when searching?

According to the previous video, do you think that the introduction of AI Overviews on Google represents an improvement in the user experience when searching?

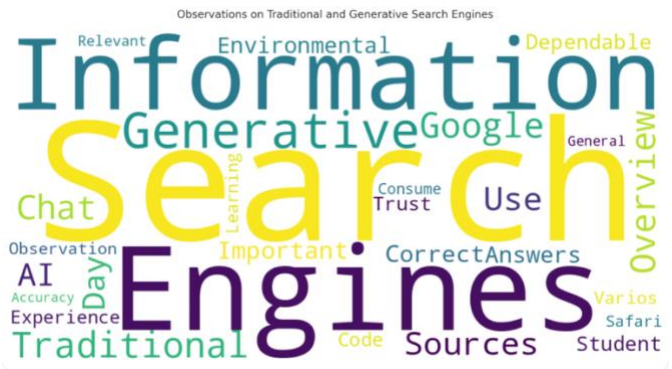
		Frequency	Percentage	Valid percentage	Cumulative percentage
Valid		4	2,0	2,0	2,0
	Yes, it allows for more precise and relevant answers.	112	56,9	56,9	58,9
	No, I prefer the traditional search engine.	12	6,1	6,1	65,0
	No opinion.	10	5,1	5,1	70,1
	Yes, but with limitations. Sometimes the answers generated are not correct.	59	29,9	29,9	100,0
	Total	197	100,0	100,0	

Appendix F - Answer to the question: In your opinion, has the growing use of responses generated by artificial intelligence (such as Google AI Overviews or ChatGPT) reduced your need to consult traditional information websites to obtain information online?

In your opinion, has the growing use of responses generated by artificial intelligence (such as Google AI Overviews or ChatGPT) reduced your need to consult traditional information websites to obtain information online?

		Frequency	Percentage	Valid percentage	Cumulative percentage
Valid		4	2,0	2,0	2,0
	No, despite having the possibility of obtaining information from a response generated by Artificial Intelligence, I still regularly go to informative websites to obtain information.	85	43,1	43,1	45,2
	Yes, I currently have a greater tendency to obtain information from an answer generated by Artificial Intelligence.	108	54,8	54,8	100,0
	Total	197	100,0	100,0	

Appendix G - Answer to the question: Please share with us your observations, experiences or opinions on the use of traditional and generative search engines.



Appendix H - Answer to the question: Have you ever seen incorrect or out-of-context answers generated by generative search engines such as Google AI Overviews, ChatGPT or Perplexity?

Have you ever seen incorrect or out-of-context answers generated by generative search engines such as Google AI Overviews, ChatGPT or Perplexity?

		Frequency	Percentage	Valid percentage	Cumulative percentage
Valid		4	2,0	2,0	2,0
	I don't usually check.	24	12,2	12,2	14,2
	No.	61	31,0	31,0	45,2
	Yes.	108	54,8	54,8	100,0
	Total	197	100,0	100,0	

Appendix I - Answer to the question: Have you ever stopped using a generative search engine because of incorrect answers?

Have you ever stopped using a generative search engine because of incorrect answers?

		Frequency	Percentage	Valid percentage	Cumulative percentage
Valid		4	2,0	2,0	2,0
	No.	161	81,7	81,7	83,8
	Yes.	32	16,2	16,2	100,0
	Total	197	100,0	100,0	

Appendix J - Answer to the question: Based on the previous video, do you think that the introduction of AI Overviews on Google represents an improvement in the user experience during the search process?

Based on the previous video, do you think that the introduction of AI Overviews on Google represents an improvement in the user experience during the search process?

		Frequency	Percentage	Valid Percentage	Cumulative percentage
Valid	Yes, it allows for more precise and relevant answers.	50	62,5	62,5	62,5
	No, I prefer a traditional search engine.	1	1,3	1,3	63,8
	Yes, but with limitations. Sometimes the answers generated are not correct.	29	36,3	36,3	100,0
	Total	80	100,0	100,0	

Appendix K - Answer to the question: Please indicate what you think is the main reason for the decrease in organic traffic to the websites you monitor or manage.

Appendix L - Answer to the question: From your perspective, do you think organic traffic is being redistributed from independent or specialized sites to platforms such as Reddit, Quora, Wikipedia, LinkedIn, and Instagram?

From your perspective, do you think organic traffic is being redistributed from independent or specialized sites to platforms such as Reddit, Quora, Wikipedia, LinkedIn, and Instagram?

		Frequency	Percentage	Valid percentage	Cumulative percentage
Valid	I haven't noticed any changes.	14	17,5	17,5	17,5
	I'm not sure.	9	11,3	11,3	28,8
	Yes, very clearly.	57	71,3	71,3	100,0
	Total	80	100,0	100,0	

Appendix M - Answer to the question: How often do you click on the traditional search results (links) below these AI answers?

How often do you click on the traditional search results (links) below these AI answers?

		Frequency	Percentage	Valid percentage	Cumulative percentage
Valid		4	2,0	2,0	2,0
	Often.	100	50,8	50,8	52,8
	Never.	22	11,2	11,2	64,0
	Rarely.	58	29,4	29,4	93,4
	Always.	13	6,6	6,6	100,0
	Total	197	100,0	100,0	

Appendix N - Answer to the question: Which websites do you think will be most affected by the introduction of Google AI Overviews?

Which websites do you think will be most affected by the introduction of Google AI Overviews?

		Frequency	Percentage	Valid percentage	Cumulative percentage
Valid	Both in similar ways.	23	28,8	28,8	28,8
	I don't know / I have no opinion.	4	5,0	5,0	33,8
	Neither of them will be harmed.	2	2,5	2,5	36,3
	Large websites (e.g. News portals, large e-commerces).	4	5,0	5,0	41,3
	Small websites (e.g. Blogs, small business websites).	47	58,8	58,8	100,0
	Total	80	100,0	100,0	

Appendix O - Answer to the question: Do you think that incorporating Google AI Overviews into the search engine will be more challenging for SEO professionals?

Do you think that incorporating Google AI Overviews into the search engine will be more challenging for SEO professionals?

		Frequency	Percentage	Valid percentage	Cumulative percentage
Valid	No.	6	7,5	7,5	7,5
	Yes.	74	92,5	92,5	100,0
	Total	80	100,0	100,0	

Appendix P - Answer to the question: In your opinion, is Generative Engine Optimization (GEO) already a relevant and differentiating factor in boosting the visibility of online content?

In your opinion, is Generative Engine Optimization (GEO) already a relevant and differentiating factor in boosting the visibility of online content?

		Frequency	Percentage	Valid percentage	Cumulative percentage
Valid		31	38,8	38,8	38,8
	I'm not sure.	1	1,3	1,3	40,0
	No, it's still very recent.	15	18,8	18,8	58,8
	Yes.	33	41,3	41,3	100,0
	Total	80	100,0	100,0	

Appendix Q - Answer to the question: Do you regularly use traditional search engines (such as Google, Bing, Yahoo, among others) to look for information online?

Do you regularly use traditional search engines (such as Google, Bing, Yahoo, among others) to look for information online?

		Frequency	Percentage	Valid percentage	Cumulative percentage
Valid	No.	2	2,5	2,5	2,5
	Yes.	78	97,5	97,5	100,0
	Total	80	100,0	100,0	

Appendix R - Answer to the question: Which traditional search engine do you use most regularly?

Which traditional search engine do you use most regularly?

		Frequency	Percentage	Valid percentage	Cumulative percentage
Valid		2	2,5	2,5	2,5
	Google.	74	92,5	92,5	95,0
	Outro.	4	5,0	5,0	100,0
	Total	80	100,0	100,0	

Appendix S - Answer to the question: How often do you use traditional search engines to find information online?

How often do you use traditional search engines to find information online?

		Frequency	Percentage	Valid percentage	Cumulative percentage
Valid		2	2,5	2,5	2,5
	Daily.	77	96,3	96,3	98,8
	Weekly.	1	1,3	1,3	100,0
	Total	80	100,0	100,0	

Appendix T - Answer to the question: Have you ever used generative search engines like ChatGPT to look for information online?

Have you ever used generative search engines like ChatGPT to look for information online?					
		Frequency	Percentage	Valid percentage	Cumulative percentage
Valid	Yes.	80	100,0	100,0	100,0

Appendix U - Answer to the question: How often do you use generative search engines?

How often do you use generative search engines?					
		Frequency	Percentage	Valid percentage	Cumulative percentage
Valid	Daily.	77	96,3	96,3	96,3
	Weekly.	3	3,8	3,8	100,0
	Total	80	100,0	100,0	

Appendix V - Answer to the question: Do you think that traditional search engines find it difficult to respond to more complex and demanding searches by users?

Do you think that traditional search engines find it difficult to respond to more complex and demanding searches by users?					
		Frequency	Percentage	Valid percentage	Cumulative percentage
Valid		1	1,3	1,3	1,3
	Yes, but only in some cases.	30	37,5	37,5	38,8
	No, they usually respond well.	5	6,3	6,3	45,0
	Yes, often.	44	55,0	55,0	100,0
	Total	80	100,0	100,0	

Appendix W - Answer to the question: In your opinion, has the growing use of responses generated by artificial intelligence (such as Google AI Overviews or ChatGPT) reduced your need to consult traditional information websites to obtain information online?

In your opinion, has the growing use of responses generated by artificial intelligence (such as Google AI Overviews or ChatGPT) reduced your need to consult traditional information websites to obtain information online?					
		Frequency	Percentage	Valid percentage	Cumulative percentage
Válid		1	1,3	1,3	1,3
	No, despite having the possibility of obtaining information from a response generated by Artificial Intelligence, I still regularly visit informative websites to obtain information.	12	15,0	15,0	16,3
	Yes, I currently have a greater tendency to obtain information from an answer generated by Artificial Intelligence.	67	83,8	83,8	100,0
	Total	80	100,0	100,0	

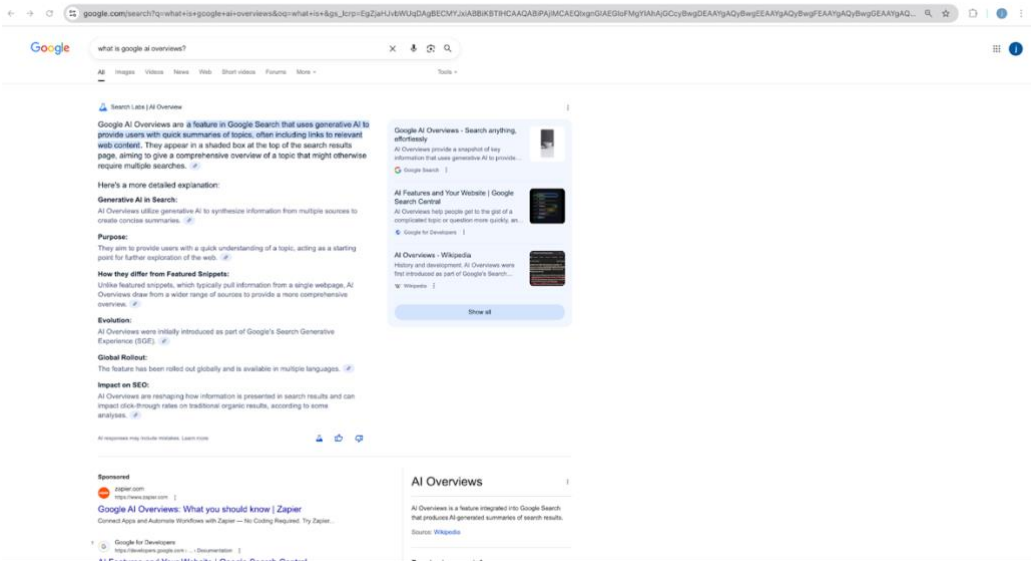
Appendix X - Answer to the question*:* Would you like to add anything about your experience with traditional and generative search engines?

Would you like to add anything about your experience with traditional and generative search engines?

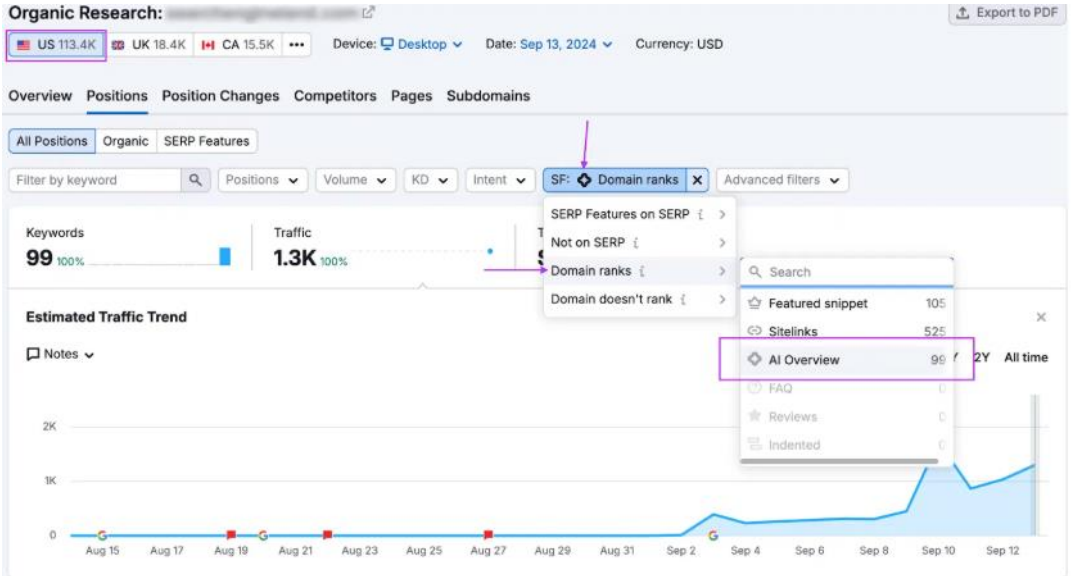
		Frequency	Percentage	Valid percentage	Cumulative percentage
Valid		1	1,3	1,3	1,3
	No.	76	95,0	95,0	96,3
	Yes.	3	3,8	3,8	100,0
	Total	80	100,0	100,0	

ANNEX

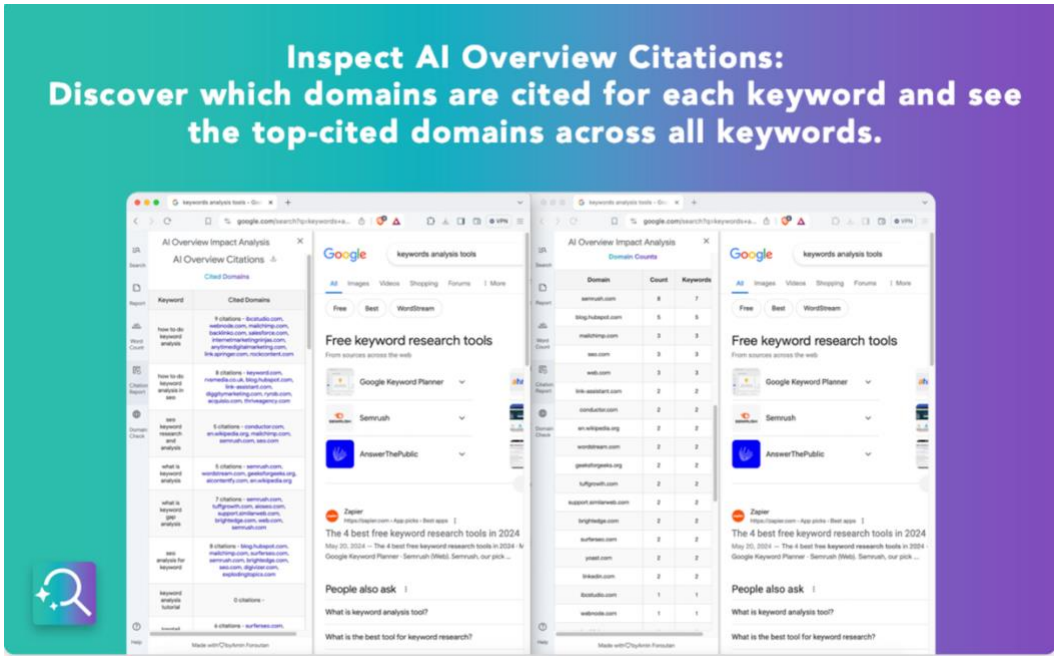
Annex A - Google Search Engine with the incorporation of Google AI Overviews



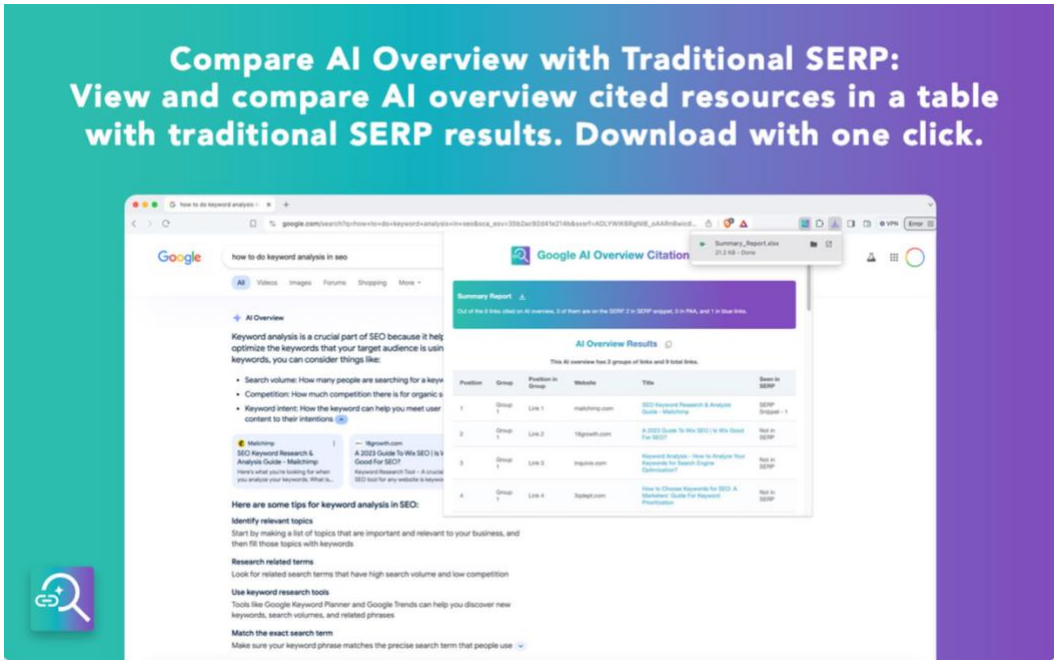
Annex B - Semrush AI Overview tracking



Annex C - Google AI Overviews Impact Analysis



Annex D - Google AI Overviews Citation Analysis



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