Case Report

Design Thinking in Innovation Processes: A Market Segmentation Tool in Social Networks Research

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Abstract: This paper outlines the purposeful adaptation and utilization of the design thinking process in an innovation case involving market segmentation in social network research. Based on a case study, this paper combines the design thinking process with systems approach methods to foster innovation in social network analyses. The paper details the entire process, from the initial stages to the development of a viable solution defined in the final assignment for programmers. The case study emphasizes the effective use of systems thinking tools and demonstrates the value of combining these two approaches to meet the needs of the innovation process. The paper aims to narrate the entire process and highlight critical points in a real-world case study. The focus was on the challenge of creating a market segmentation tool for researchers and marketers in the realm of social network analysis.

Keywords: design thinking; systems thinking; rich picture; market segmentation tool

1. Introduction

Today, for all designers, combining the design process with systems approaches has become common. This study describes the innovation process conducted by the marketing research group at the Faculty of Economics and Management at the Czech University of Life Sciences, Prague. The existing literature often treats market segmentation and design thinking as separate approaches to innovation in marketing research. However, there is a notable lack of research that integrates design thinking with systems thinking to improve segmentation processes in the context of social networks. This gap is significant, as existing segmentation models are unable to capture the dynamic and complex nature of social media environments. Without this integration, current methods fail to address the rapid evolution of consumer behavior in digital markets. By combining these two methodologies, our research aims to create more adaptive and responsive segmentation tools for modern marketers.

Innovation plays a pivotal role in marketing by driving competitive advantage and fostering organizational growth [1]. According to the Oslo Manual [2], innovation can be classified into product, process, marketing, and organizational innovations. Our focus is on marketing innovation, which involves the implementation of new marketing methods, including significant changes in product design, placement, promotion, or pricing strategies [2].

Marketing innovation is crucial for adapting to rapidly changing market environments, especially with the rise of digital platforms and social media [3,4]. It allows firms to better meet customer needs, open up new markets, and improve their market share [5]. Tunç explores the significant impact of marketing innovation on customer loyalty, mediated by brand image and customer satisfaction [5]. This highlights that marketing innovation not only helps businesses remain competitive but also fosters stronger customer relationships through enhanced brand perception.

During the past ten years, design thinking has evolved rapidly and broadly [6], which has created a lot of potential for designers and systems engineers to work in the field of innovation processes. This encouraged us to write a case study about creating and combining approaches in marketing research. Despite the growing use of design thinking and systems thinking in innovation, there is a significant research gap regarding their combined application in the context of market segmentation within social network research. This paper aims to fill this gap by exploring the synergy between these two approaches to develop a dynamic segmentation tool. In this paper, we present the innovation process driven by the systems approach combined with design thinking as a powerful tool to manage the innovation team in the case of market segmentation. The central aspect of the design thinking methodology is its focus on deep user understanding of markets [7], and it facilitates the creative transformation of the knowledge base into new concepts [8].

Design thinking is a human-centered approach to innovation that integrates the needs of people, the possibilities of technology, and the requirements for business success [9]. It emphasizes empathy, ideation, prototyping, and iterative testing, making it suitable for tackling complex problems in marketing [10]. Liedtka [10] highlights that design thinking can lead to more innovative outcomes by fostering a deeper understanding of user needs.

Systems thinking offers a holistic approach to understanding complex systems by recognizing interconnections and patterns among system components [11]. In marketing, systems thinking helps in understanding the broader market ecosystem, including customer behavior, market trends, and the impact of marketing strategies [12]. According to Nguyen and Bosch, systems thinking enables a more comprehensive analysis of market dynamics [12].

Combining design thinking with systems thinking creates a powerful framework for innovation. Design thinking brings creativity and user-centricity, while systems thinking ensures a comprehensive understanding of the market environment [13]. This integrated approach enhances the ability to develop innovative solutions that are both user-friendly and systemically viable [14]. Carlgren et al. [14] emphasize that framing design thinking within a systems perspective can lead to more effective innovation processes.

Analyzing social networks and working with data for marketing shows that the fundamental problem in this area is segmentation for marketing purposes. Segmentation in terms of geographic location is key to creating international marketing and effective targeting. The situation described led us to start an innovation process using system approaches. As it turned out, this is not a process that is well described in the current literature, especially in relation to its practical application.

Recent studies have emphasized the importance of integrating innovation processes into market segmentation. Zolfagharian and Ier utilized machine learning algorithms to identify hidden patterns in consumer data, leading to more effective segmentation [15]. Das [16] explored how marketers can leverage geographic, demographic, and personal information from social media platforms to enhance market segmentation and innovation in their campaigns, providing deeper insights into consumer preferences. These studies demonstrate that integrating innovative processes into market segmentation is essential for addressing the complexities of modern markets [16].

Despite the importance of market segmentation, there is a notable lack of research integrating design thinking and systems thinking to innovate this process, especially within social network research. While each approach individually fosters innovation [9,11], few studies have explored their combined application in marketing, missing potential synergistic benefits [14,17].

Traditional segmentation methods relying on static demographic or geographic data fail to capture the dynamic nature of consumer behavior in the digital age [18]. Although big data analytics and machine learning have been recognized as transformative tools [19,20], practical frameworks that effectively merge these technologies with human-centered design are scarce.

Furthermore, the evolving landscape of social media presents new challenges for market segmentation [21]. Limited research exists on leveraging social media insights through an integrated design and systems thinking approach to develop innovative segmentation strategies [12].

The goal of the article is to improve the design thinking process using tools from the systems approach. The article emphasizes the main problems that can arise during the process, along with techniques that are combined and integrated into the design thinking framework. The problem situation concerns a new market segmentation process that we developed over the past few years.

It is evident that traditional segmentation methods often rely on static demographic or geographic data, which may not capture the dynamic nature of consumer behavior in the digital age [18]. Innovative market segmentation leverages big data analytics, machine learning, and social media insights to identify more nuanced and dynamic consumer segments [19].

The intersection of innovation processes and market segmentation has gained attention in the recent literature. Verhoef et al. [22] discuss how digital transformation necessitates innovation in market segmentation, emphasizing the role of big data and analytics. They argue that firms must adopt new technologies and innovative processes to remain competitive. Von Briel, Davidsson, and Recker [23] highlight the importance of customer-centric innovation processes in developing effective market segmentation strategies. They suggest that digital technologies serve as external enablers of new venture creation and innovation in market segmentation. Rozhko [24] highlights that digital innovations enable organizations to swiftly respond to evolving market conditions, which is crucial for dynamic segmentation driven by social media data. This aligns with our approach to leveraging digital tools for more adaptive market segmentation strategies.

1.1. Market Segmentation

Market segmentation in the field of marketing research focused on social networks is a crucial part of any marketing strategy. The proper segmentation and understanding of markets provide powerful tools for planning communication with customers.

Market segmentation is a fundamental marketing strategy that involves dividing a broad target market into subsets of consumers with common needs or characteristics [20]. Traditional segmentation methods often rely on static demographic or geographic data, which may not capture the dynamic nature of consumer behavior in the digital age. Davenport et al. [18] argue that the integration of big data and analytics is transforming market segmentation.

Innovative market segmentation leverages big data analytics, machine learning, and social media insights to identify more nuanced and dynamic consumer segments [19]. This approach allows for real-time analysis of consumer preferences and behaviors, leading to more personalized and effective marketing strategies. For instance, Hofacker, Malthouse, and Sultan [19] discuss how big data and consumer behavior analytics are opening new opportunities for market segmentation. Similarly, to Hofacker et al. [19], new technologies, such as machine learning and big data analytics, present opportunities for more nuanced market segmentation [25]. These tools enable marketers to identify consumer patterns in real time, leading to more personalized and effective marketing strategies.

The current market segmentation into developed and developing countries or Eastern and Western Europe, often used in global advertising campaigns, faces several challenges. According to the study by Hofstede [26], cultural factors play a fundamental role in the effectiveness of advertising campaigns, often not reflected in traditional segmentation models. Another study [27] suggests the need to shift from the standardization to the adaptation of marketing strategies to align with the specific characteristics of individual markets. This need is supported by the work of Khokhar [28], criticizing outdated and insufficiently differentiated categorizations of countries into "developed" and "developing." Overall, these sources indicate that effective global advertising campaigns require more

nuanced, detailed, and flexible market segmentation, reflecting cultural, economic, and other relevant differences among regions and countries.

In the realm of digital marketing and social media analytics, the mining of user behavior stands as a transformative approach to understanding the multifaceted dynamics of consumer interaction and engagement within digital platforms. This process is not merely a technical endeavor but rather an interdisciplinary pursuit that combines principles from computer science, data mining, machine learning, and social network analysis to construct a holistic representation of consumer behavior patterns [29].

The significance of this approach has been underscored through diverse studies, reflecting its applicability and consequential insights in various domains, such as sustainability, public health, and corporate social responsibility, to name a few. However, these research endeavors often adopt a global lens without adequate consideration for the nuanced distinctions in message reception and consumer behavior predicated in regional and developmental contexts [30–32].

The conventional segmentation of 'developed' and 'developing' regions, as critiqued by the World Bank and scholars [28], suggests an oversimplification of global dynamics, failing to capture the intricate economic, social, and digital disparities that characterize today's interconnected world. This critique not only challenges the status quo but also calls for a more dynamic, nuanced, and perhaps individualized approach to market segmentation, especially in the context of the burgeoning digital economy and the pervasive influence of social media.

In the scholarly discourse on country classification and its operational significance, researchers such as Nielsen [33] and Tezanos Vázquez [34] have emphasized the utility of classification systems in navigating the complexities of global development and policy implementation. However, the debate extends beyond operational logistics, delving into the realm of equitable development, ethical governance, and global solidarity. Koch's contribution to this debate highlights the contentious nature of existing classifications within the European Union context, advocating for a multidimensional perspective on development that transcends mere economic indicators [35].

Furthermore, the work of [36] resonates with this argument, pointing out the inadequacies in existing taxonomies that often blur the lines between country groupings, thereby complicating policy relevance and application in an increasingly heterogeneous global landscape.

In synthesizing these scholarly insights, it becomes evident that the field of digital marketing and social media analytics must evolve in tandem with these global shifts, adopting more fluid, context-aware, and culturally sensitive segmentation strategies. This paradigm shift is not just about enhancing market reach or consumer insight, but is fundamental to promoting inclusive development, digital equity, and sustainable growth in the global digital economy.

Market segmentation is a crucial strategy in marketing, allowing companies to divide the market into groups of potential customers with similar needs and characteristics [37]. Furthermore, the importance of market segmentation in specific areas or industries, such as pharmaceuticals and medical marketing, has been emphasized, suggesting that strategic market segmentation presents an opportunity to integrate medical and marketing activities [38].

Social media has become a significant factor in influencing consumer behavior and marketing strategies. It provides a platform for interactive engagement, which can enhance brand equity and influence consumer decision-making processes [39].

Mobile applications are essential in modern marketing, enabling personalized and direct communication with consumers. Bencsik et al. [40] highlight their significance, particularly for Generations X and Y, noting that "mobile marketing is considered the most dynamically growing segment of marketing communication" [40]. Mobile apps enhance customer engagement, purchasing decisions, and satisfaction [41]. Recent data show that more than 90% of social media users access platforms via mobile apps, highlighting the

crucial role of mobile in marketing strategies. Narang and Shankar [42] further emphasize the importance of mobile apps in targeting and cross-channel marketing.

Consumers utilize social media for various purposes, including information search, product evaluations, and post-purchase satisfaction levels, impacting their decision-making journey, particularly in the tourism and hospitality industry [43]. Studies have shown that social media usage has increased during the pandemic, influencing consumer behaviors related to product needs, information searches, product comparisons, and purchases [44]. A huge number of studies show that social media impacts their behavior and decision-making [45–47]. Such a trend can impact market segmentation because social media provide new opportunities for targeting and understanding consumers. Another significant study [48] explores how a lack of free time has become a symbol of status in certain cultures. This can influence market segmentation by revealing new possibilities based on social and cultural factors. Finally, Kumar [49] focused on the role of customer engagement in services. This can affect market segmentation by highlighting the importance of customer interaction and engagement in creating effective marketing strategies.

The goal of the paper is to describe a case study of the innovation process in creating a new approach for market segmentation in social media research. The added value of such innovation lies in combining the design thinking systems approach and modeling techniques.

1.2. Systems Thinking

The system theory and systems thinking can find their starting point in the 1968 General System Theory in a revised version [50]. It is founded on understanding the general principles of complex systems in nature [22].

Systems thinking can be described as an approach that emphasizes understanding the whole and the complex [51], which entity contains interrelationships, interactions, dynamics, and the system's boundaries [52].

In most sources, we found that systems thinking is a holistic approach combining analysis, critical thinking, and systems thinking. Systems thinking is recognized as a critical ability for engineers who take a leading role in complex projects [53]. Semantic analysis and broad definition feature in [51], where all analyses are compared to the definition: Systems thinking is a set of synergistic analytic skills used to improve the capability of identifying and understanding systems, predicting their behaviors, and devising modifications to them in order to produce desired effects. These skills work together as a system.

Methodologically, the process of systems thinking demands highly experienced users who are able to work with a holistic view together with dynamics [54], which could be observed by their behavior [55]. In educational processes, systems thinking could be very difficult but beneficial to academia [56,57].

In this case study, we use and combine the approaches from the soft system methodology (SSM) based on P. Checkland's work [58], summarized in [59]. The procedure of the SSM is based on the understanding of system structures, their parts, and connections. To attain this understanding, we use a set of methods (models), such as Checkland's seven-stage models in [60] or other rich pictures [61] or roots definitions [62].

2. Methodology

Design thinking or 'designerly thinking' are two different points of view [6]. In this case study, we use the first approach, which goes beyond the designer's skills (architecture, art) and is more about creating an innovative space [6]. This approach was developed by the Hasso-Plattner Institute of Design at Stanford [63].

The current research gap lies in design thinking and systems thinking to innovate the market segmentation process within social network research. This approach is justified for several reasons.

Firstly, user-centric innovation: Design thinking focuses on understanding the needs and behaviors of users [9]. In market segmentation, this means creating segments that reflect actual consumer behavior and preferences, leading to more effective marketing strategies. Liedtka [10] notes that design thinking can reduce cognitive biases and lead to better innovation outcomes.

Secondly, holistic understanding: Systems thinking allows us to consider the entire market ecosystem, recognizing the interdependencies between different market factors [12]. This is crucial when dealing with complex social network data where consumer interactions are dynamic and multifaceted.

Thirdly, enhanced innovation capability: Combining both approaches enhances the organization's ability to innovate by fostering creativity while ensuring solutions are grounded in systemic reality [64]. Magistretti et al. [64] emphasize that design thinking can trigger and sustain organizational innovation by engaging stakeholders and empowering decision-making within corporate structures.

By integrating design thinking and systems thinking, we aim to develop a dynamic and adaptive market segmentation tool that addresses the limitations of traditional methods. This approach aligns with the need for innovative strategies in marketing to respond to rapidly changing consumer behaviors and market conditions [4]. Nambisan, Wright, and Feldman [4] emphasize that digital transformation requires new approaches to innovation and entrepreneurship.

The combination of both approaches—systems thinking and design thinking—were developed together. The basics of design thinking can be found in Simon's 'The Structure of Ill-Structured Problems' [17]. Both approaches contribute to the evolution of teams along with a precise procedure and innovation potential. The design thinking process has been described in various contexts, such as technical and professional communication programs, urban redevelopment, digital preservation, and higher education startup development [65–67].

The whole process will be dynamic and must be managed by design thinking experts. The expertise of these experts, combined with extensive experience in systems design, will streamline the entire process [68].

The whole process can be decomposed into five phases, but it is often reduced to four—the first two phases should lead us to the description of the situation [69]. Here, the statement that "all the participants are familiar with situations" could be used—and that is the point where the critical failure will appear. Based on our own experience and observations, we can say that common problems are often due to a misunderstanding of the whole picture of the situation.

In each phase, the description is based on defining the problem in marketing research, using a combination of design methodology and soft system methods. In this process, you can revisit previous phases as needed.

1. Phase: Empathy

   - Problem situation: A broad description is created, highlighting complex "messy" problems in fields such as business and healthcare [70–72].
   - Research and literature reviews: Literature research is conducted to summarize the current state of knowledge [73].
   - Empathic mapping: This technique helps understand user needs, aiding in the creation of personas [74].

Phase Empathy [75] creates a complex situation description and serves as the starting point for the whole process.

2. Phase: Definition

Precise definition of the problem based on findings from the first phase—Empathy. The second phase is crucial, especially in relation to the correct delineation of relevant data. Brevity can be one of the main causes of success or failure. The goal of this phase is to provide clear and meaningful frameworks for the third phase in the design thinking process, especially for the Ideation phase.

- Summary of findings: Summary of information from the Empathy phase is prepared.
- Problem Formulation: Insights are rephrased into a clearly defined problem [76].
- Creation of the Problem Statement: A concise statement is created to emphasize user challenges [77,78].
- Setting Goals and Requirements: General goals are set, becoming more specific as the process continues using SMART methodology [79].

3.　Phase: Ideation

In this phase, we begin generating solutions, and it is a crucial phase in the process [80]. The team should engage in creative activities to develop a broad set of ideas that can lead to a wide range of design solutions [81]. Commonly used methods during ideation include the methods generating and encouraging the innovation process itself, such as:

- Brainstorming;
- Mind mapping (other tools—root definitions, rich pictures);
- SCAMPER;
- Competitive analysis and best practices, etc.

4.　Phase: Prototype

Prototype is the fourth phase in the process, involving the construction of a prototype of a mobile application to enrich the user experience among senior citizens [82]. Prototyping focuses on creating tangible versions satisfying the user with the completed design or prototype [83].

The Prototype phase is divided into:

- Selection of ideas for prototyping: The first part is to choose the most promising ideas from the Ideation phase that will be transformed into prototypes. When selecting, relevance to the defined problem, feasibility, innovativeness, and potential impact on users should be considered.
- Creating prototypes: Prototyping involves creating a simplified, physical, or digital version of the idea. In the context of our problem, it could be a simple software model for dynamic segmentation that includes key features and tools. In process, there is a possibility to run parallel prototyping [84] to create more possible solutions—but it is based on the current situation.
- Iteration: The iterative approach to prototyping is widely recognized as a valuable method for refining designs and improving outcomes [85]. Based on the feedback received, the team can adjust the prototype, add or remove features, and even go back to the Ideation phase for more ideas.
- Documentation and presentation: It is essential to document the results of prototyping and present them to other team members or stakeholders.

5.　Phase: Testing

The final phase is the testing of the prototype—it follows the complete development of the software. The testing phase is crucial as it allows for the refinement and evolution of ideas, narrowing down the problem space [86]. We will evaluate its effectiveness and how well it meets user requirements. This includes collecting and analyzing feedback from potential users and adjusting our solution based on this information. The Prototype phase [87] has to lead to the evaluation, adjustment, and replay of prototypes to inform decision-making based on successive iterations or versions. The output of this process should be powerful and user-friendly software for dynamic segmentation, bringing significant benefits to the fields of global advertising planning and strategic management.

3. Case Study

Our case study describes the development process, which was led by a designer together with marketers, analysts, and programmers. We used brainstorming and idea meetings together with systems and design techniques. Nevertheless, each creation is different based on the environment and team setup.

We divided the case study into five phases, similar to the design thinking framework (see Section 2)—but it is still necessary to see that the point is in the dynamics of the whole process.

3.1. Case Study—Phase 1: Empathy

Design thinking is an iterative process and a user-centered approach to problem-solving that considers end-user opinions, expectations, and needs [88]. For Phase 1, we use the persona set-up—a procedure used in standard marketing studies. Personas are a methodology for representing fictional individuals who consist of groups of people with shared behavioral patterns, demographics, and interests [89] (see Tables 1 and 2). Services marketing research has used personas to illustrate the findings of qualitative and phenomenological studies both intuitively and empathically [90]. Furthermore, personas are utilized in branding strategies, such as targeting Hispanics on social media, to create persona-focused branding strategies using aspects of specific identities [91]. In the context of marketing and advertising, personas play a significant role in supporting professional advertisers to design adverts for social media, impacting advert performance and empathy [92].

Table 1. Person Charles—prime person.

Role
Researcher in the field of social media
Description
Charles is a 35-year-old researcher in the field of social media. He works for a renowned research institution in Prague and specializes in analyzing user behavior on various social platforms. He has a Ph.D. in social sciences with a focus on digital media.
Goal and needs
Charles aims to understand how user behavior varies across different platforms and geographical areas. He needs a sophisticated tool to analyze large amounts of data and identify key trends and patterns. He would also like the ability to share his findings with other members of his team and collaborate on projects.
Challenges and frustrations
Charles often encounters problems when attempting to segment data from different sources. He also struggles with interpreting complex datasets and creating understandable reports for his colleagues and superiors.
Technological skills
As a researcher in digital media, Charles is highly technologically literate. He can use advanced analytical tools and has basic programming knowledge.
Personal values and motivations
Charles is motivated by the pursuit of knowledge and understanding complex patterns. He values precision and detail in his work and wants his study to make a genuine impact on the world of digital marketing.

Table 2. Person Anna.

Role
Head of marketing at a global advertising agency
Description
Anna, 45 years old, has been working in marketing for over 20 years. She is responsible for planning and implementing global advertising campaigns for her clients.
Goal and needs
Anna is looking for an effective way to segment markets for her global campaigns to make them as tailored as possible to local markets and cultures.
Challenges and frustrations
Anna often encounters problems when trying to segment data from different sources. She also has difficulty interpreting complex datasets and creating understandable reports for her colleagues and supervisors.
Technological skills
She is technically adept and open to new technologies.
Personal values and motivations
Anna faces issues with the current segmentation, which is too general and does not consider the specific characteristics of individual markets. She needs a tool that would allow her to better understand and target different market segments.

Description of the problem: We need to understand how current market segmentation influences the outcomes of global advertising campaigns and gain a deeper understanding of user needs and their context. To address this problem, it is crucial to comprehend the needs and constraints of marketing professionals dealing with global advertising campaigns.

This can be achieved through interviews with marketing managers, advertising specialists, and other experts in this field who utilize existing segmentation modes. Understanding these perspectives will help us better grasp why existing models are insufficient.

This phase concludes with the last part, which is summarizing the previous phase into the so-called Definition.

3.2. Case Study—Phase 2: Definition

Summary: In the design of global advertising campaigns, traditional segmentation models—such as developed vs. developing countries or Eastern vs. Western Europe—are still commonly used. However, these approaches have become outdated and insufficient in today's globalized world. How can we develop a dynamic segmentation model that more accurately reflects the real characteristics and needs of various regions and markets in the global marketing landscape?

Problem definition: To identify the problem (description of problem situations)—we use a variety of methods for different types of problems. For more complex problems, we integrate precise methods like root definition (CATWOE, mind maps, etc.). CATWOE is a system thinking tool that was developed by David Smyth in 1975 and 1976 [93] as a 6-phase method for analyzing problems from various perspectives within a system [93]. The CATWOE analysis helps reduce complex situations into key relevant ones [94]. To define the problem, we need to estimate Actors and Transformations which are likely to be crucial parts of the problem—see Table 3.

Table 3. Determination of the problem based on CATWOE.

CATWOE		Combine to Problem Statement
Name	Description	
Customers	Marketers/scientists who require dynamic knowledge about markets.	
Actor	Informatic, designers, analysts, and customers.	The problem is to establish an informatics procedure for obtaining data from customers to obtain accurate analysis by analysts at the local level.
Transformation	Gaining precise data based on owners' needs from the market to create the right results for the analysis of markets at the local level.	
Worldview	The belief that the right decision from marketers is based on quality data with the correct interpretation forms the fundamentals for quality decision-making.	
Owner	Companies and boards of companies.	
Environment	The market situation at the local level, social networks at the general level, and the condition of the economy.	

The final stage is the creation of a "problem statement" (in Table 3) and "objectives and requirements". After applying the appropriate method (in our case, CATWOE), we need to go back and make them explicit.

Goals and requirements: "Marketing experts need an efficient and flexible tool for market segmentation that enables the creation of global advertising campaigns that are more targeted and relevant to various cultural and economic contexts".

3.3. Case Study—Phase 3: Ideation

We use rich pictures as a valuable tool within the Soft Systems Methodology (SSM) to understand complex systems and facilitate collaborative problem-solving. They provide a pictorial summary of the actual situation in the "systems world" based on inquiries or observations of the "real world" [95]. This technique is particularly useful for co-creative meaning-making in collaborative self-study research [96].

For visualizing a situation, problem, system, or process in the broadest context, we utilized phases 1 and 2. In the case of our problem with segmentation in advertising campaigns, a rich picture helped the team understand the entire ecosystem of the global advertising industry and the diversity of markets. Based on the input information, we were able to extract the following:

- Market mapping: An image showing different markets, how they are currently segmented, and identifying key factors important for each segment. This visualization includes information on how these markets differ and how they are interconnected.
- Actor identification: Identifying all key actors in the advertising ecosystem, including advertisers, advertising agencies, consumers, and regulators. We create an understanding of how these actors are interconnected.
- Process understanding: A rich picture aids in visualizing the entire process of creating and implementing advertising campaigns. This includes market selection, development of creative concepts, media planning, campaign execution, and result measurement.
- Problem and challenge identification: Using a rich picture (Figure 1), we identify where in the system there are issues with segmentation. We pinpoint the most significant challenges and areas where a new approach could be most beneficial.
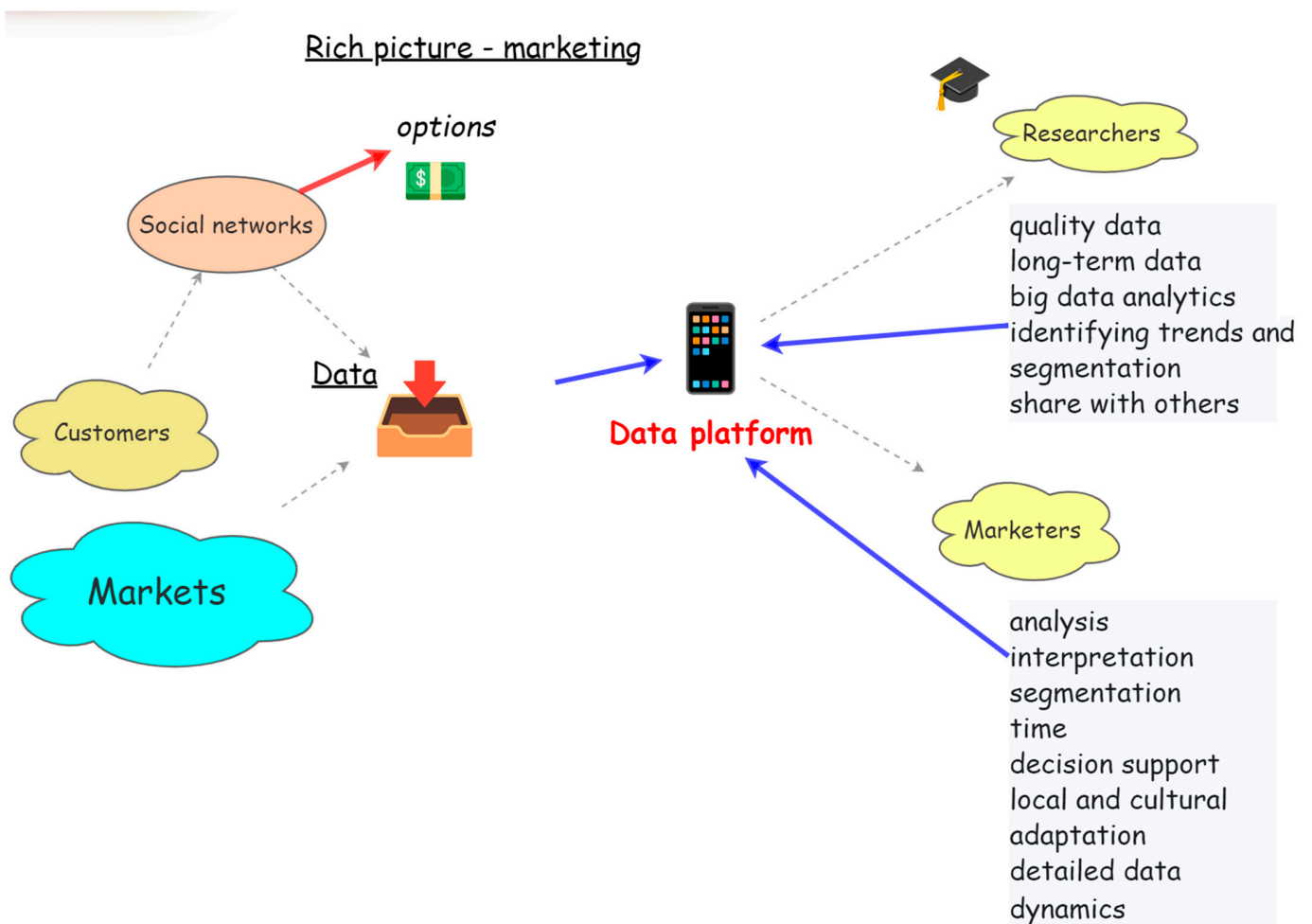
Figure 1. Basic rich picture.

After a few meetings, the main aspects and components appear—we call them key and they are crucial.

3.4. Case Study—Phase 4: Prototype

The prototyping phase is the primary focus of this case study, detailing the entire process from data processing to display design. The following section describes each phase. While this approach may not represent the only way to address the problem, it has been validated through multiple iterations as the most effective solution for the specific challenges we defined.

Input data

The application would start by collecting data from various social media sources. This could involve public posts, comments, reviews, tweets, and other forms of content related to keywords or topics specified by the user.

The input for the content analysis is the individual contributions, which are extracted from a suitable network according to the available sources. In our case, the dataset originated from Twitter. These data were tagged with the hashtag "zerowaste". This phase is critical to reaching all the data. The restrictions across social media are increasing, and so are the costs.

Data transformation and data preprocessing

The dataset is loaded and transformed into a NoSQL document-oriented database. This allows for the efficient storage and retrieval of data operation results without consuming excessive RAM, enabling specific queries and the selection of states within the dataset.

Textual data (Tables 4 and 5) from social media often contain noise, such as emojis, URL links, hashtags, etc. Preprocessing would involve cleaning the text of these elements, as well as removing stop words and normalizing the text (e.g., converting all text to lowercase).

Table 4. Dataset—input.

Text	Hashtags	Place_Country_Code	Developed/Developing
Another reason we love @trytheworld: post-ind...	#zerowaste	US	developed
500,000,000 foam trays eliminated from schools	#ZeroWaste	US	developed
#ZeroWaste is #MoreThanPossible—Japanese Tow...	#ZeroWaste #MoreThanPossible #StoriesToInspire	US	developed
And so, my fellow humans, ask not what your En...	#zerowaste	US	developed
Out with the old? Changing how we see our 'old...	#ZeroWaste	US	developed

Table 5. Dataset—one row of input data.

Number of Rows	247,235
Example line	Another reason we love @trytheworld: post-indulgence it becomes spice storage! #zerowaste https://t.co/7QvoseEfV3, accessed on 14 October 2024

Data pre-processing is divided into two parts, where first we remove empty rows from the data and then the data are cleaned by a carefully planned process. The data cleaning process, though not novel, is a critical phase in the overall data processing workflow. Proper attention must be given to this phase to prevent the degradation or distortion of the dataset, which could lead to biased results when dealing with large volumes of data. Whole pre-processing is as follows (data from Tables 4 and 5 to data in Table 6):

A. Remove insufficient lines

- if the value in columns text, country_code, or developed/developing is empty, the whole line is removed;
- Number of rows: 247,209.

B. Cleaning data

- ensure all values in the column text are of type string;
- convert all values in the column text to lowercase;
- remove all hashtags, hyperlinks, user mentions, special characters, numbers, newline characters, multiple spaces, consecutive duplicate words, words shorter than three characters;
- remove emojis;
- translation to English (if intended, only for models trained in English);
- remove stop words—a list of words without any impact on clustering, for example:

C.   Remove insufficient lines

- During the dataset cleaning process, new empty values may appear in the "text" column. These are addressed and removed using the procedure described in Section A.

Table 6. Dataset—at the end of procedure.

Number of Rows	240,303
Example line	another reason love post indulgence becomes spice storage

Online Topic Modeling

For the purposes of topic models, we use "incremental topic modeling"—the ability of a neural network to learn incrementally from small batches of cases. This approach not only allows for updating a topic model with new, previously unseen data but also helps prevent out-of-memory errors by processing data in manageable portions rather than all at once.

This study's primary data processing approach is to identify the relevant topic headings that emerge in user discussions. Given that the data (such as tweets) are not pre-labeled into categories, we employ unsupervised learning methods, specifically clustering techniques, to group the data into more general themes, which facilitates the analysis of these discussions (see in Table 7).

Table 7. Dataset—topic modeling.

Document	Topic	Name	Representation	Representative Docs	Top_n_Words	Representative Document
another reason love post indulgence becomes sp...	8	8_year_happy_great_new	[year, happy, great, new, time, waste, zero, m...]	NaN	year—happy—great—new—time—waste—zero	False
foam trays eliminated from schools per year su...	5	5_food_easy_make_need	[food, easy, make, need, great, free, waste, u...]	NaN	food—easy—make—need—great—free—waste	False
japanese town produces trash	7	7_easy_waste_zero_new	[easy, waste, zero, new, make, amp, need, free...]	NaN	easy—waste—zero—new—make—amp—needed	False
and fellow humans ask not what your environmen...	4	4_free_happy_planet_new	[free, happy, planet, new, help, year, use, ma...]	NaN	free—happy—planet—new—help—year—us	False
out with the old changing how see our old stuf...	3	3_use_single_plastic_let	[use, single, plastic, let, reduce, products, ...]	NaN	use—single—plastic—let—reduce—produce	False

For this purpose, we utilize BERTopic, a topic modeling technique that leverages the BERT architecture—an advanced neural network architecture designed for natural language processing tasks. BERTopic combines BERT with c-TF-IDF (class-based term frequency-inverse document frequency) to create dense clusters of related content. This approach allows for the generation of easily interpretable topics while preserving the significance of key terms in the topic descriptions.[1]

Visualization

The application provides visual representations of the analysis, applying topic-per-class clustering that allows for representation of how clusters are represented over a category such as country (Figure 2A) or development level (Figure 2B).[2]

(**A**) Topics per country
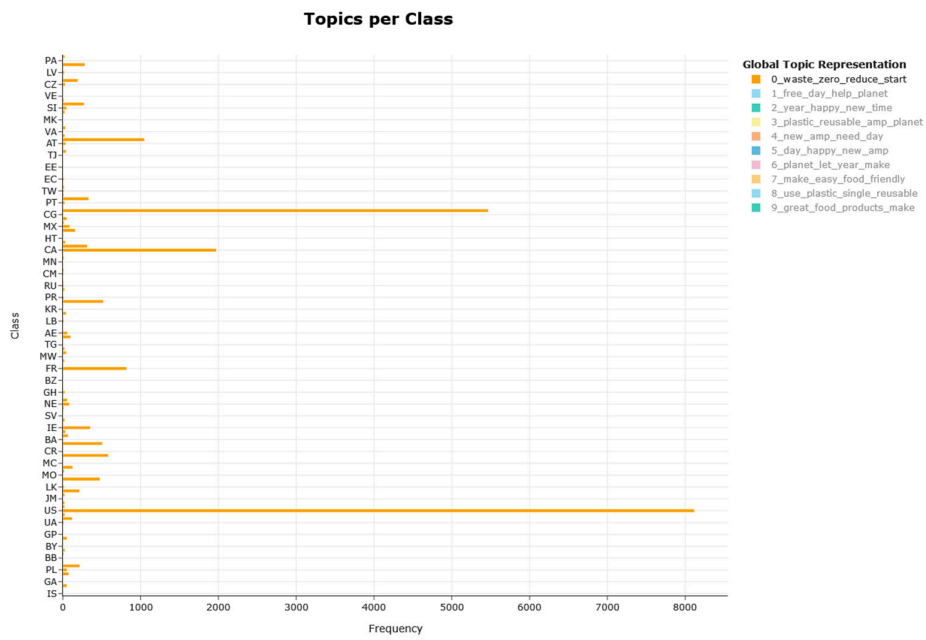
(**B**) Topics per development level
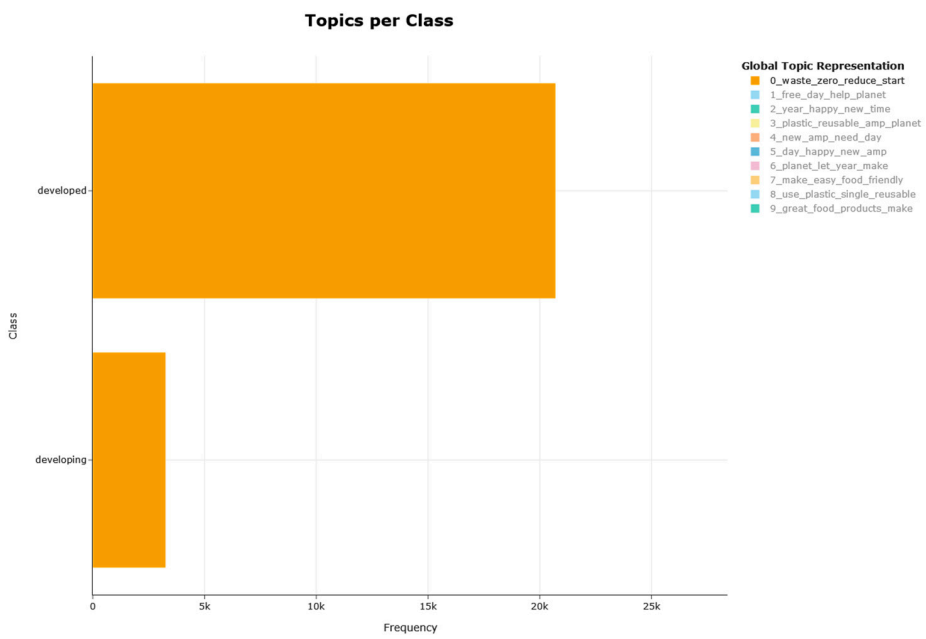
Figure 2. *Cont.*

(**C**) Topics per development level

Similarity Matrix

(**D**) Topic bar chart

Topic Word Scores
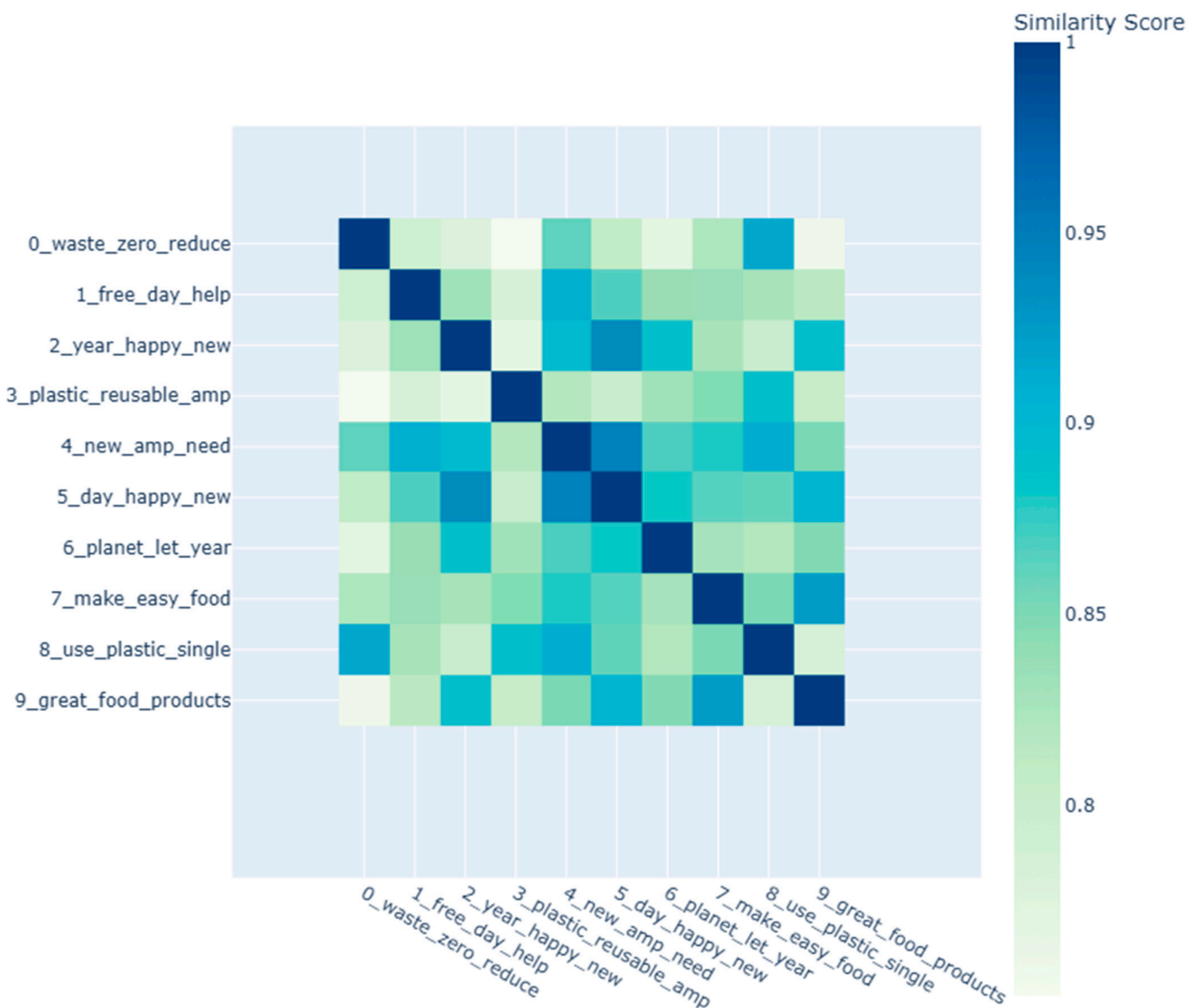
Figure 2. Visualization possibilities (**A**–**D**).

We then provide more visualization ideas to understand the clustered data. Based on the cosine similarity matrix between c-TF-IDFs or semantic embeddings of the topics, a heatmap is created showing the similarity between topics (Figure 2C). Visualizing a bar chart of selected topics may also help to understand the results (Figure 2D).

Design of Application—Tool for Users

An application for an adaptive and dynamic approach to market segmentation. Built on advanced algorithms for processing social media data, it offers methods for analyzing and interpreting sentiment and engagement in different geographic regions.

Wireframe of the Created Design

Using a wireframe as the basic tool for the developers (MockFlow WireframePro, version 1.0.3) will help us create the whole structure of the software tool; see Figure 3.
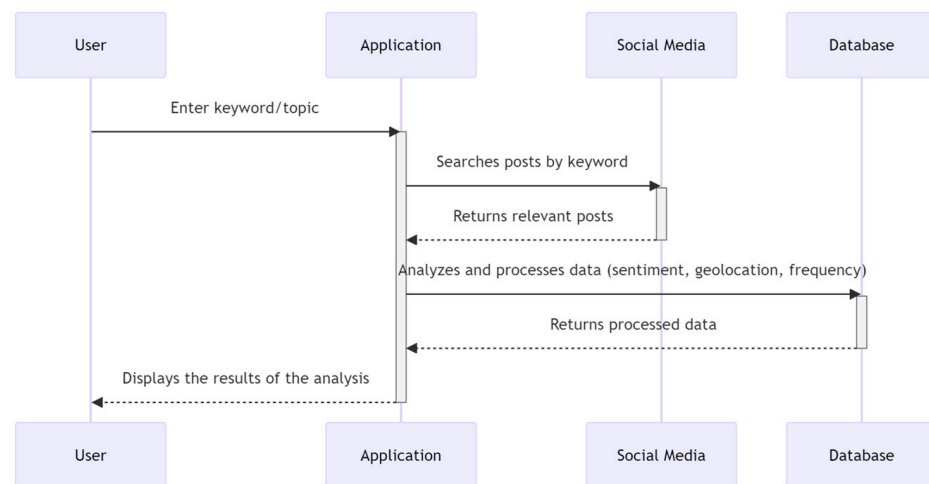
Figure 3. Sequence diagram.

In Figure 4, we present a mockup of the home page of the proposed market segmentation application, showcasing its user-friendly interface and advanced functionality. The home page is designed with a central input field for users to specify their topic of interest, accompanied by a sophisticated filtering system. This system allows users to refine their data sources into four distinct categories: text-based, hashtag-based, weighted influence, and image-based segmentation. Additionally, the page offers sentiment-based filtering options, enabling users to narrow down their search to posts with positive, negative, neutral, or indeterminate sentiments. Geographical filtering is also available, with options such as Europe, Asia, America, and others, facilitating region-specific analysis. The interface further includes a section displaying a list of previously explored topics and the segments created from them, providing users with a historical overview and easy access to past analyses.

Figure 5 displays a mockup of the page dedicated to showcasing groups of countries with similar communication styles in relation to the analyzed segment. This page features a table that provides a focused breakdown of these groups. The table includes columns for the dominant topic (the theme most frequently associated with each group of countries in relation to the studied segment), the prevailing sentiment within the group, the number of countries in each group, and their respective abbreviations.
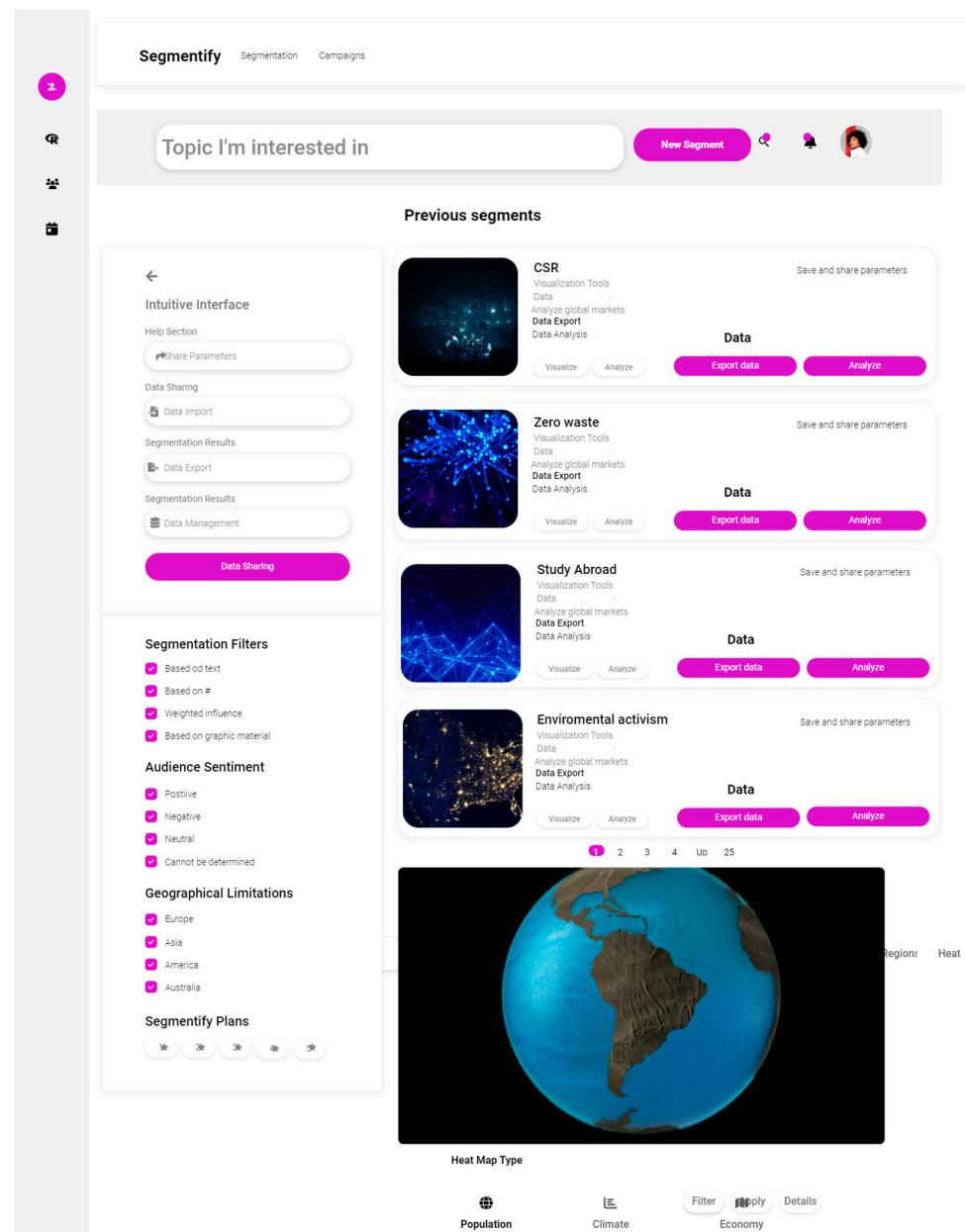
Figure 4. Home page.

A key highlight of this page is an interactive world map, which visually emphasizes these groups, delineating the countries based on their shared communication styles in the context of the analyzed segment. In this specific example, the map illustrates four distinct groups, offering users an intuitive and engaging way to understand global patterns and similarities in communication related to the segment.

Figure 6 presents a mockup of the audience discovery page within the market segmentation application, designed to assist users in identifying suitable audiences for their topics of interest. This page enables users to select specific countries, and in response, the tool generates a list of topics that are common across these selected countries and share the same sentiment. This feature allows for a nuanced understanding of cross-country similarities in public discourse and sentiment.
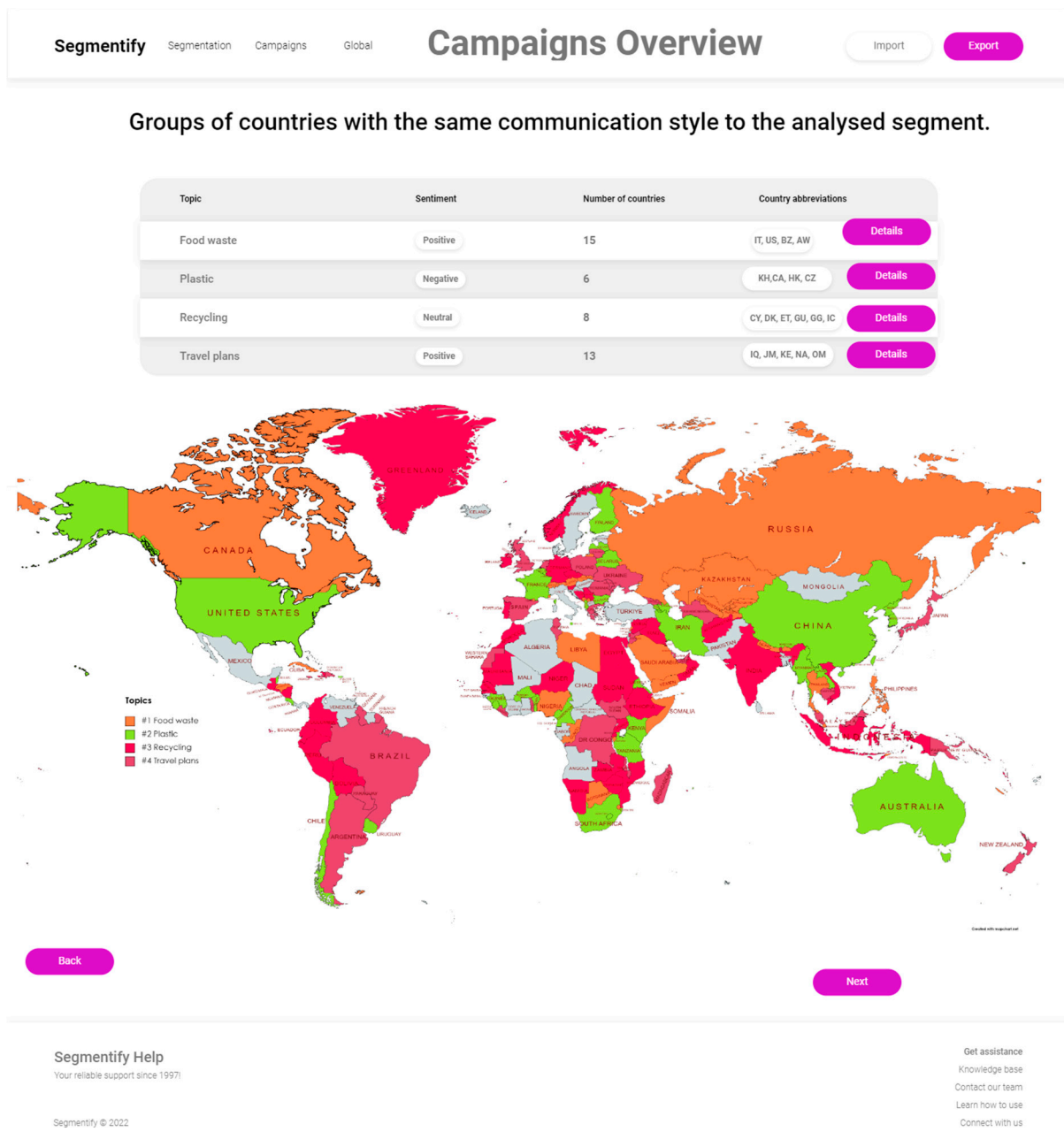
Figure 5. Overview of selected segments.

The page also includes an interactive world map, which highlights the countries chosen by the user, visually representing the geographical scope of their inquiry. Additionally, the page maintains the same advanced filtering capabilities found on the home page, offering users the flexibility to refine their search based on four distinct categories: text-based, hashtag-based, weighted influence, and image-based segmentation.

Figure 7 illustrates a mockup of the page designed for creating specific advertising campaign proposals based on the results of the market segmentation analysis. This page is equipped with sophisticated data filtering options, mirroring those on the home page, which include text-based, hashtag-based, weighted influence, and image-based segmentation categories.

Figure 6. Groups of countries with the same sentiment.

A notable feature of this page is the 'Audience Demographics' section, providing in-depth demographic insights into the selected audience segments. This aids advertisers in tailoring their campaigns to specific market characteristics. Additionally, the page offers advanced campaign customization settings, allowing users to define the intended sentiment of the campaign, target-specific population densities, income groups, and other demographic details of the target audience. These settings enable a more nuanced and targeted approach to campaign creation.
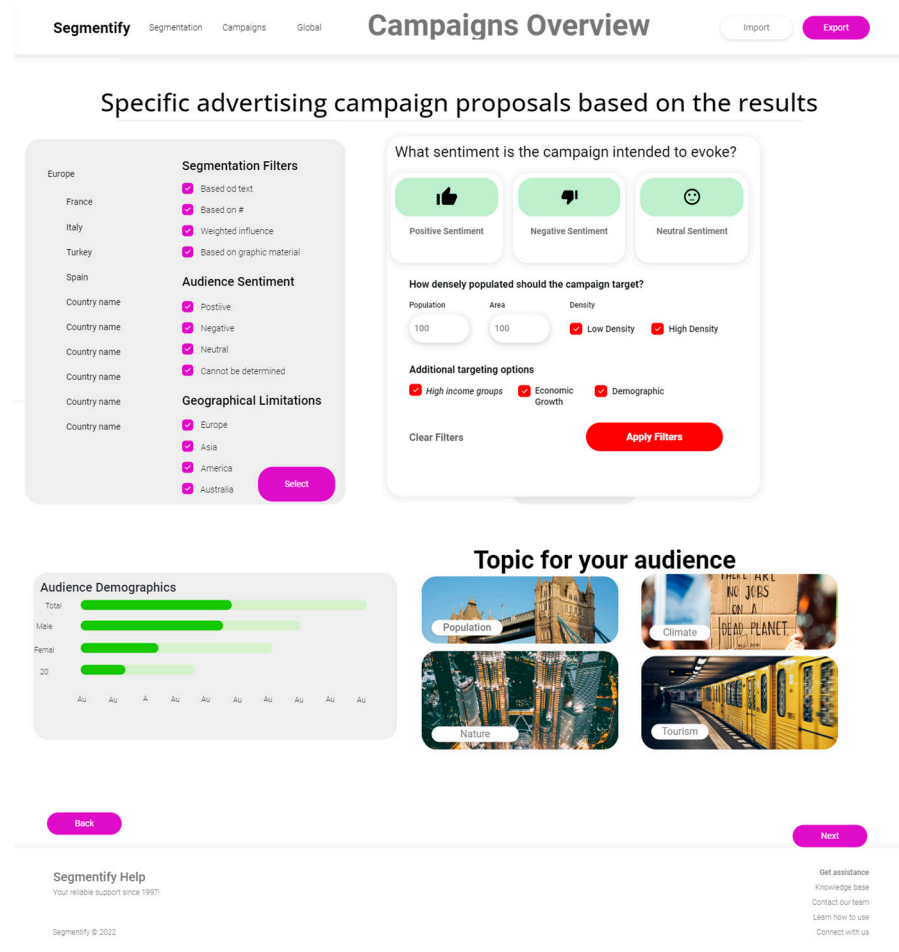
Figure 7. Overview of campaign proposal.

The core of this page is the section that presents concrete advertising theme proposals. In this example, the page suggests four distinct themes for advertisements. These themes are carefully chosen based on their potential to resonate effectively with the selected countries in a global advertising campaign. This feature is crucial for marketers seeking to create data-driven, impactful advertising strategies that are finely tuned to the preferences and characteristics of different market segments.

Figure 8 presents a comprehensive visual representation of the functions and structure of the market segmentation application. Those functions were created in the whole process through the testing. The mindmap delineates the core components and their respective sub-categories, encapsulating the intricate system designed for the analysis and segmentation of data derived from social media platforms. The text methodically outlines the process of collecting data from various social media channels, emphasizing the acquisition of diverse content types. It also highlights subsequent stages of data preprocessing, including content cleaning, text normalization, and filtering irrelevant words. The map also delves into the geographic segmentation aspect, illustrating the application's ability to determine the origin of posts and perform regional sentiment analysis. The mindmap provides a guide to the application's architecture and operational dynamics, including the sentiment analysis module, quantitative and qualitative analysis features, and data visualization techniques.
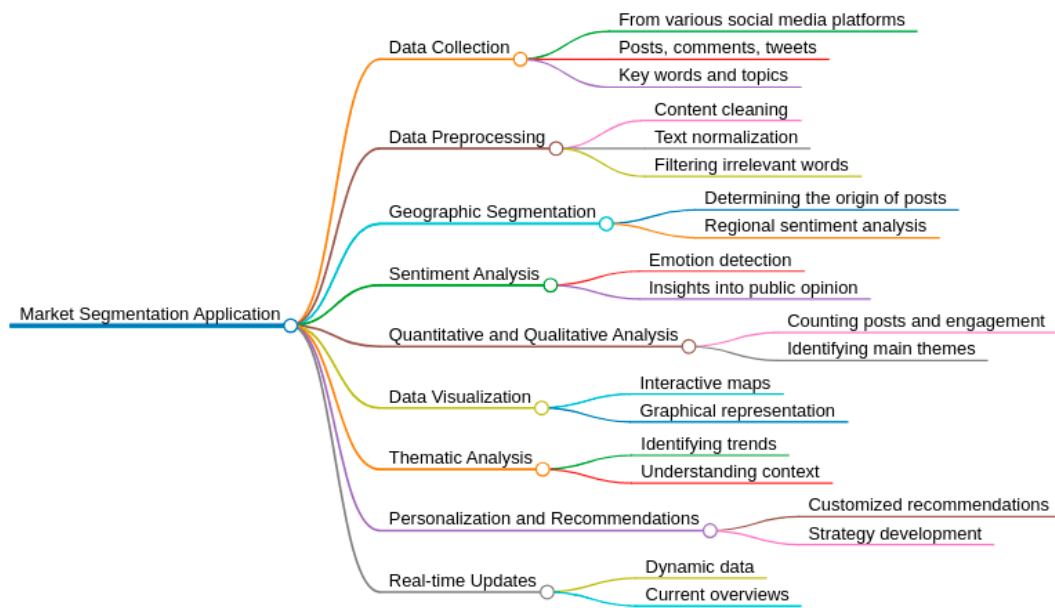
Figure 8. Functions and structure of the market segmentation application.

3.5. Phase: Testing

The final phase is the testing of the prototype—it follows the complete development of the software. We shall evaluate its effectiveness and how well it meets user requirements. This includes collecting and analyzing feedback from potential users and adjusting our solution based on this information.

The output of this process should be powerful and user-friendly software for dynamic segmentation, bringing significant benefits to the fields of global advertising planning and strategic management.

4. Results and Discussion

In the case study (see Section 3), we demonstrated the use of the design thinking process. We implemented practical applications of the systems approach (CATWOE, rich picture) into the process. This approach is suitable for any innovation procedure. As is evident from the presented study, their application is beneficial and appropriately used in the innovation process. While a considerable number of methods related to these approaches can be found in the literature, it is important to document the extension of the methodology of the design thinking process.

4.1. Results

In the case of market segmentation, the goal of the design process application was to create an application with features derived from the design process. We developed the tools for market segmentation, which are:

1. Thematic Engagement and Sentiment Analysis: The application systematically explores social media to identify countries with high levels of engagement in specific topics. It conducts both quantitative and qualitative analysis of posts, including sentiment analysis. This approach provides a detailed understanding of the cultural and demographic specifics of various topics, which is crucial for effective global communication and marketing strategies.
2. Personalized Topic Selection for Different Countries: This feature allows users to selectively analyze topics that resonate in specific countries, providing data on preferences and trends unique to those regions. This feature is essential for tailoring marketing and communication strategies to specific cultural and social contexts, maximizing the relevance and impact of these initiatives.

3. Interactive Live Map of Trends: The application provides a visual representation of current market data and trends through an interactive map, updated in real time. This visualization provides users with an immediate overview of market dynamics and consumer behavior patterns, essential for informed strategic decision-making.
4. Comprehensive Overview of Social Media Segments: The application provides an integrated view of online discussions regarding specific topics, including sentiment analysis, activity levels, and convergence points of discussion across different states. This view allows researchers and practitioners to better understand and respond to the global dynamics of public opinion and consumer behavior.

4.2. Key Contributions

The text emphasizes a combined approach of design thinking (user-centered) and systems thinking (holistic perspective). This combination supports innovation by offering adaptive and responsive segmentation models, especially useful for complex, fast-changing environments such as social media. The CATWOE and rich picture methodologies highlight the systems perspective, while design thinking adds the practical, iterative process.

Innovation in Market Segmentation: By creating tools tailored for dynamic social network segmentation, the study applies these methodologies to uncover cultural and demographic insights from social media. Key tools include Thematic Engagement and Sentiment Analysis, Personalized Topic Selection, Interactive Live Maps, and Comprehensive Social Media Segment Overviews. These tools reflect advanced methods to analyze and interpret consumer behavior on social networks, bridging big data analytics and design.

Big Data and Machine Learning in Marketing: The theoretical approach integrates machine learning and big data analytics, which are essential in the modern digital marketing landscape. The study shows that these technologies enable a nuanced understanding of consumer preferences and behaviors, aligning with a human-centered approach in practical applications for real-time social network analysis.

Empirical Validation through Case Studies: The practical applications of the integrated methodology are demonstrated through empirical evidence, such as case studies on market segmentation and application design. The validation process, including testing with the "Zerowaste" dataset, strengthens the theoretical foundations by showcasing real-world effectiveness.

Dynamic Adaptation for Future Research: The study's framework points to ongoing development and testing for future advancements. The dynamic nature of the approach suggests future potential in expanding text analytics and other AI-based procedures, allowing for continuous adaptation in social network analysis and market segmentation.

This theoretical foundation not only offers a structured process for developing innovative segmentation tools but also contributes to a more holistic understanding of consumer behavior in digital marketing, emphasizing the value of interdisciplinary approaches.

In summary, the testing of the application revealed that it successfully provides dynamic insights into market segmentation through advanced sentiment analysis, real-time data visualization, and topic clustering. These features were demonstrated to effectively highlight geographic and demographic patterns in social media data, offering valuable tools for global marketing campaigns. Furthermore, the application's adaptability to different regions and its ability to analyze consumer sentiment across various platforms were key outcomes of the development process.

4.3. Discussion

The results of our case study clearly demonstrate that integrating design thinking with systems thinking enhances the capabilities of market segmentation tools, particularly in social media analysis. The developed application successfully captures real-time data, making it highly adaptable to changing consumer sentiment and trends. This flexibility is crucial for marketers who need to constantly adjust their strategies based on real-time insights. The primary outcomes include the ability to generate dynamic, culturally sensitive

campaigns and provide visual, data-driven insights via interactive tools such as maps and sentiment analysis.

Our case study presents an integrated approach, which combines design thinking and systems thinking to innovate the market segmentation process and aligns with recent efforts in the literature to address the complexities of modern marketing environments. Buchanan [17] emphasized the importance of integrating systems thinking with design thinking to tackle complex challenges, which supports our methodology [17]. Hofacker et al. [19] discussed the opportunities that big data and consumer behavior analytics present for market segmentation, consistent with our use of social media data for dynamic segmentation. Carlgren et al. [14] explored how framing design thinking within a systems perspective can enhance innovation processes, reinforcing our methodological approach. Nguyen and Bosch [12] applied systems thinking to identify leverage points for sustainability in complex environments, which is directly relevant to our approach in market segmentation. Different frameworks of market segmentation research mostly concern behavioral segmentation [97,98].

By applying these frameworks to social network analysis, our study extends the scope of the existing research into more dynamic, real-time market segmentation approaches. This contributes not only to the theoretical foundation of marketing innovation but also to practical applications in global advertising strategies. Menon explores the integration of systems thinking and design thinking in the context of Industry 4.0, emphasizing how these approaches can foster innovation in fast-changing environments, which aligns well with our focus on dynamic market segmentation in social networks [99].

Therefore, our study extends these works by applying the combined approach specifically to social network analysis for market segmentation, contributing to the advancement of both theoretical and practical aspects of market segmentation and marketing innovation.

However, one of the main challenges remains the scalability of the application, especially when processing large datasets across multiple platforms. While the current tool performs well with mid-sized datasets, future iterations will need to incorporate more advanced machine learning algorithms to handle larger volumes of data. Additionally, the integration of predictive analytics could enable the tool to not only react to current trends but also forecast future shifts in consumer behavior. This would provide marketers with a forward-looking advantage, allowing them to anticipate market changes rather than just responding to them.

The key contributions of this research include the development of a dynamic segmentation tool that leverages the strengths of design thinking and systems thinking. By integrating these two approaches, this tool allows marketers to create more targeted and culturally sensitive campaigns, particularly in the context of global advertising. Moreover, the use of real-time data visualization tools, such as interactive maps and sentiment analysis, enhances the ability to track and respond to market trends effectively.

In conclusion, the combination of design thinking and systems thinking has proven to be an effective framework for developing dynamic market segmentation tools. Moving forward, future research should focus on improving the tool's scalability and integrating predictive analytics to refine its capabilities further. Moreover, exploring how this tool can be adapted to other marketing contexts, such as product innovation or customer journey mapping, could significantly enhance its applicability. By addressing these challenges, the application has the potential to revolutionize how businesses approach global marketing strategies in the digital age, offering a more comprehensive and forward-thinking approach to market segmentation.

5. Conclusions

The article makes a key theoretical contribution by integrating design thinking and systems thinking to create a dynamic framework for market segmentation in social networks. This combined approach enhances innovation by merging user-centered methodologies with a holistic systems perspective, allowing for more adaptive and responsive segmenta-

tion models in the digital age. It advances the application of big data and machine learning in marketing, emphasizing how these technologies can uncover nuanced consumer behaviors when aligned with human-centered design. By bridging theory and practice, the article provides valuable insights for both academics and practitioners seeking to innovate in social network analysis and market segmentation.

In this case study, we outlined a comprehensive design-driven innovation process for addressing market segmentation needs. The goal was to create a new tool tailored for computer scientists, combining various available methods in an optimal way. The designed tool was prototyped and tested to meet the specific requirements of marketing professionals. Additionally, the procedures were validated using the "Zerowaste" dataset.

In the innovation process, combining design thinking with other methodological approaches proves to be highly advantageous. While innovation is often a derivation of existing systems, it is typically driven by a new perspective on a problem and an unconventional approach to solving it. The real-world challenges in innovation must be thoroughly examined and reconsidered by all stakeholders.

In our paper, we presented a case study of the creation of a new market segmentation tool.

The process of creating a new tool for marketing research and practice with a focus on practical application is the result of a combined approach. The aim was to innovate the existing dynamic field of social network analysis and to address both methods for processing and approaches to large volumes of social network data. By combining both issues, it was possible to gain a comprehensive overview of customer behavior and individual topics. The proposed application (platform) is currently under development and testing with all stakeholders. However, it is already proving to be suitable for our further research needs. As the project progresses, its capacity to adapt to real-time data and provide dynamic segmentation insights will be further refined. This flexibility makes the platform a valuable tool for marketers looking to respond quickly to shifting market conditions. So, as seen in the whole procedure, the complexity of big data evaluation has further potential for future research in implementing new text analytics and other AI procedures. Future iterations of the platform may also explore predictive modeling, enabling the more accurate forecasting of consumer trends and behaviors, which will be crucial for maintaining a competitive advantage in an increasingly data-driven marketplace.

This study addressed defined gaps by proposing an integrated approach that combines design thinking and systems thinking to innovate the market segmentation process within social network analysis. Through a real-world case study, we demonstrated how this approach can lead to a dynamic and adaptive segmentation tool that reflects the complex and evolving nature of consumer behavior on social media. The key contributions can be divided into three parts:

The presented study makes a dual contribution to both theoretical and applied perspectives. Theoretically, it expands market segmentation models to incorporate holistic, dynamic, and data-centered methodologies. Practically, the application provides a robust toolset for professionals in marketing, public relations, and consumer analytics, offering a structured yet flexible approach for addressing diverse segmentation needs. This contribution thus positions our integrated framework as a foundation for further exploration into data-driven, adaptive marketing strategies.

The study demonstrates the strategic advantage of merging design thinking with systems thinking to develop a novel and dynamic approach to market segmentation, especially within the context of social network analysis. This hybrid framework effectively addresses the complexities and fluid nature of consumer behavior on social media, providing actionable insights into cultural and demographic segmentation. The integration of sentiment analysis, real-time data mapping, and customized topic tracking has shown significant potential in improving marketing responsiveness and relevance. Through a rigorous case study using the "Zerowaste" dataset, we validated the tool's applicability in practical settings, proving its capability to yield precise, data-driven segmentation.

By combining human-centered methodologies with advanced analytics, the framework facilitates the development of adaptive market strategies. This approach not only streamlines traditional segmentation processes but also enables nuanced analysis across global and culturally diverse audiences. The tools developed—such as the interactive live map and sentiment analysis features—illustrate how companies can monitor real-time trends and adapt quickly to shifts in public sentiment, thus aligning their marketing strategies with actual consumer interests and regional dynamics. This adaptability is essential in a rapidly evolving digital environment, where insights need to be both timely and context-specific.

In summary, the integration of design thinking and systems thinking in the development of this segmentation tool represents a significant progress in addressing the complex and dynamic needs of modern marketers. This innovative approach not only improves segmentation strategies in the digital age but also sets a precedent for future research at the intersection of human-centered design and big data analysis. Future work could expand this methodology to other areas of marketing, providing even more comprehensive tools for businesses aiming to stay competitive in a rapidly evolving global market.

Limitation of Research

Despite its significance, market segmentation faces several limitations. Traditional methods often fail to capture the complexity and fluidity of modern consumer behavior, especially in digital markets where preferences change rapidly [100]. Over-segmentation can lead to data overload, making it difficult for marketers to interpret and utilize the information effectively [20]. Additionally, ethical concerns regarding privacy and data usage have become more prominent with the reliance on personal data for segmentation [101]. These challenges highlight the necessity for more dynamic, adaptable, and ethically responsible approaches to market segmentation. In the context of leveraging social media data for market segmentation, it is crucial to address the ethical concerns surrounding data privacy, consent, and the responsible use of consumer information. The increasing reliance on big data analytics, machine learning, and social network insights raises important questions about how personal data are collected, processed, and utilized. Marketers must ensure that their practices comply with data protection regulations such as GDPR and respect user privacy by obtaining explicit consent for data use. Additionally, there is a growing need to balance personalization in marketing strategies with the potential risks of over-targeting and surveillance. Ethical considerations should also extend to transparency, ensuring that consumers are informed about how their data are being used and that they have control over its application. By addressing these ethical challenges, businesses can foster trust, protect consumer rights, and contribute to more responsible and sustainable marketing practices.

Design thinking often prioritizes creativity and ideation, which can sometimes result in solutions that are not practical or feasible in real-world applications. It has been described as a "paradigm" in the innovation management literature [102]. The primary practical limitations arise from constraints such as budget, time, and resources. Its iterative process, involving frequent revisiting of previous outputs, can also be time-consuming.

In the empathy phase, empathetic understanding is essential [103], and a misunderstanding of the problem can occur. While systems approaches may help mitigate this issue, they do not offer instant solutions. Misinterpreting users' needs or preferences can result in solutions that fail to address the core problem. Additionally, the human factor can limit effectiveness in different situations [104].

Additionally, design thinking typically leads to incremental improvements [105] rather than radical innovations, making it less suitable for businesses seeking disruptive or groundbreaking solutions. Although it works well for small teams or projects, scaling the process across larger organizations can be challenging. Communication, collaboration, and the iterative nature of the process may become complex and less efficient.

Moreover, the use of systems tools may lead to oversimplification. Breaking down complex problems into smaller parts can sometimes overlook systemic or broader organizational issues. The limitations of the suggested procedure include the tools used in our case study. We used personas, one of the most common tools [106,107], but it depends on many factors and which tool can be used based on various situations [108].

Despite these limitations, we demonstrated how significant improvements can be achieved by combining the design process with system tools. This approach highlights the relevance of design thinking as an effective mechanism for sustaining growth and enhancing brand equity [109].

In future research, the application could implement machine learning algorithms to analyze historical data and predict future trends. Prediction is a crucial parameter for marketing purposes, and there are various approaches to such predictions. It will be appropriate to add such features to the software in the future. Future development will primarily involve addressing two main areas: predictive analysis of trends and audience segmentation.

Notes

1. BERTopic (maartengr.github.io).
2. URL: https://maartengr.github.io/BERTopic/getting_started/topicsperclass/topicsperclass.html (accessed on 16 May 2024).

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