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INFLUENCE OF AI TOOLS ON CONSUMER BEHAVIOR MANAGEMENT IN DIGITAL MARKETING

Introduction. *With the rapid advancement of digital technologies, online advertising has become essential for effective brand communication with target audiences in digital spaces.*

Problem Statement. *It has been hypothesized that artificial intelligence (AI) tools can enhance the effectiveness of advertising campaigns, leading to increased sales, higher profits for advertisers, and improved returns on marketing investments.*

Purpose. *This study aims to examine the impact of AI tools on managing consumer behavior in digital marketing.*

Material and Methods. *An experiment has been conducted on the Meta Ads platform to compare the outcomes of advertising campaigns configured with AI tools versus manual settings. Two test groups of advertising campaigns have been selected based on the competence and awareness of the management targets. Using Kohonen maps, the reflexive characteristics of the management targets in these groups have been assessed. By employing both manual settings and AI tools, an experiment has been carried out by a digital marketing specialist to modify potential customers' reflexive characteristics and investigate changes in their behavior regarding targeted actions within the advertising campaigns. Results have been compared across both configurations.*

Results. *The study has shown that AI tools enable effective influence on user behavior in digital spaces. AI-generated recommendations have led to increased reach, clicks, and conversions from ad links, with the greatest efficiency observed when targeting potential customers. Potential areas for further research have also been identified.*

Conclusions. *Leveraging AI tools in Meta Ads campaigns enables advertisers to increase product sales and improve returns on marketing investments.*

Keywords: *artificial intelligence, AI tools, behavior management, reflexive management, digital space, digital marketing, Meta Ads, advertising campaign performance, marketing research.*

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In today's world, with the rapid development of digital technologies, online advertising has become an integral component of effective communication between brands and their target audiences in the digital space. Increasing competition and evolving consumer demands drive the need for new, more effective marketing tools for promoting products and services. The swift evolution of digital platforms and social networks has provided marketers with fresh opportunities to reach markets with their products and services. At the same time, the use of artificial intelligence (AI) in marketing offers extensive potential for personalizing and optimizing advertising campaigns.

Since 2018, the adoption of AI tools has gained considerable traction among leading corporations, spurring further innovation growth [1, 2], the research firm McKinsey [3] named 2023 “the breakthrough year of artificial intelligence.” According to McKinsey's findings, more than half of organizations currently use AI and plan to continue doing so in the future.

A Forbes study [4] has found that 64% of business owners expect AI to improve customer relationships and increase productivity, while 60% anticipate that AI tools will drive sales growth, and 59% believe AI will help optimize costs. AI is also valued for enhancing decision-making (44%), reducing response times (53%), and minimizing errors (48%).

Research by Daugherty & Wilson [5] reports that the development of AI is transforming business practices and creating new requirements for the workforce. Meanwhile, AI tools are enhancing organizations' ability to leverage data for forecasting, significantly reducing forecasting costs [6]. According to Gartner's technological trend AI has been listed as the top strategic technology [7]. Gartner predicts that by 2025, AI tools will yield measurable returns on investment through improvements in decision-making processes, business model development, ecosystem enhancements, and customer experience optimization.

A key trend in modern marketing is the use of AI-driven recommendations to enhance the effec-

tiveness of digital advertising campaigns. AI algorithms can analyze vast amounts of data on users, including behavioral patterns, interests, and past interactions with ads, to forecast campaign outcomes and predict shifts in consumer behavior [8–10]. By leveraging these insights, digital marketing specialists can adapt campaigns to capture maximum attention from potential customers and boost their motivation to make purchases, ultimately leading to increased sales.

Popular AI tools used in marketing to improve campaign performance include Persado Motivation AI, Nosto, Jasper, Phrasee, Meta Ads, Google Ads, Market Brew, SEO Surfer, Frase.io, MarketMuse, GrowthBar, Seventh Sense, LivePerson, Smartwriter.ai, and Cogito [10, 11]. These tools can be categorized based on the specific tasks they address. For example, Persado Motivation AI, Nosto, Jasper, and Phrasee are designed for content marketing, aiding in the creation of compelling ad copy. For search engine marketing (SEM), tools like Meta Ads, Google Ads, Market Brew, SEO Surfer, Frase.io, MarketMuse, and GrowthBar enhance the chances of engaging potential customers through search engines. Direct marketing tools like Seventh Sense, LivePerson, Smartwriter.ai, and Cogito enable the creation of effective personalized messages for clients. The choice of tool depends on the business's unique needs, product type (goods or services), target audience's concentration points, and budget for advertising.

Among these, the two largest platforms, Meta Ads (formerly Facebook Ads) and Google Ads, significantly influence digital advertising trends by allowing advertisers to reach users on Facebook and Google [12, 13]. Both tools offer detailed campaign configuration options, and their built-in AI algorithms enable optimization for better performance.

In the realm of AI tools in marketing, there is a hypothesis that such usage can increase advertising campaign effectiveness, resulting in higher product sales, increased advertiser profits, and improved return on marketing investments [10, 11].

The impact of AI-driven recommendations on digital marketing performance remains a topic of

active discussion and research among contemporary Ukrainian and international scholars.

In her study of AI applications in the marketing activities of trade enterprises, N. V. Proskurnina [14] concludes that such tools enable businesses to better understand their consumers, thereby making marketing communications more effective and improving the return on marketing investments.

Analyses of AI use in the marketing analysis of unstructured data [15] and consumer profiling [16] led S. E. Khrupovych to conclude that AI tools not only facilitate and expedite the analytical work of marketing professionals but also allow marketers to shift from understanding the client as a consumer to understanding the client as an individual.

K. Yu. Korsunova's research on the overall influence of AI on international digital marketing [17] demonstrates the effectiveness of AI and emphasizes the need for its adoption in the marketing activities of Ukrainian enterprises.

An overview of AI tools in digital marketing and an exploration of their roles has been conducted by A. Halim [18], R. Boddu [19], and B. Razor [20]. The authors note that AI algorithms' data collection and processing capabilities allow marketers to (1) quickly determine the most effective content to target toward clients and (2) identify the optimal channel to use at the appropriate time. The authors emphasize that AI tools enhance client satisfaction with advertising interactions and that AI's impact on advertising effectiveness will continue to grow.

P. Kopale's research [21] focuses on current trends and future research opportunities for AI tools in marketing. The author highlights the importance of concentrating on two significant capabilities of AI in marketing: human-machine interaction and the automated analysis of text, audio, images, and video.

I. Herman explores the ethical perspectives of using artificial intelligence in marketing for the public good [22]. The author argues that ethical principles should not impede technological prog-

ress but rather enhance AI applications that promote social and environmental well-being. Global perspectives and risks associated with AI in economic activities have previously been examined by V. Atanasov [23], S. Zuboff [24], N. Dyer-Witheford [25], and J. Schiengof [26] among others, who link the use of AI with the emergence of a new economic system – digital capitalism. The risks associated with digital capitalism, including the dominance of tech giants, cybersecurity vulnerabilities, and the erosion of personal privacy, are pressing issues in the fast-evolving digital economy, necessitating close investigation and resolution.

The widespread use of AI tools in the digital space calls for research on their impact on users, their capabilities, and potential risks. In particular, attention must be given to the hypothesis that AI tools in the digital space may alter user behavior and influence decision-making. This type of informational influence, which shifts the behavior of a target toward a specific decision, is related to the concept of reflexive management in control theory. Thus, employing approaches and mathematical tools from reflexive management is appropriate for formalizing the phenomenon under study. The foundational concepts and tools of reflexive management, including those applied to marketing, are presented in the works of R. Thaler [27–29], C. Sunstein [28], L. Hanser [29], V. Arrow [30], D. O. Novikov [31–32], A. G. Chkhartishvili [32–33], D. O. Gubanova [32], V. O. Korepanov, V. V. Shumov [33], O. Yu. Mintz [34, 35], S. S. Turlakova [36–41], and Y. M. Shumylo [42, 43], among others. Given that digital marketing mechanisms are rooted in the principles of reflexive management, applying relevant tools to address the outlined objectives will facilitate identifying target groups of economic agents for directed marketing influence and estimating the likelihood that users in the digital space will perform a target action, thereby enabling predictions of advertising campaign effectiveness.

The findings of this study may contribute significantly to understanding the role of AI tools in modern advertising strategies, supporting a more

informed selection of optimal approaches to achieve marketing goals.

The need to test this hypothesis justifies the article's objective: to investigate the impact of AI tools on consumer behavior management in digital marketing.

To conduct the study, an experimental method is proposed. The procedure is as follows:

The overall task is defined as follows. During the launch of an advertising campaign, the marketing specialist aims to maximize the number of target actions by potential customers, such as subscribing to the company's profile, leaving comments, sending messages, filling out forms, or clicking on links. In this context, the marketing specialist acts as the control subject (CS), who seeks to influence potential customers to encourage specific, beneficial decisions. Here, the potential customer assumes the role of the control object (CO).

In the course of influence, certain parameters in the CO's decision-making mechanism are altered, which we define as the reflexive characteristics of the CO. Reflexive characteristics within the scope of decision-making processes among economic agents in the digital space include: the agent's level of awareness, competence, intentional orientation, and engagement intensity within the digital environment [36, 43].

For this study, we will examine a case where the CS, in pursuit of control objectives, uses an AI tool integrated into the Meta Ads platform to influence the reflexive characteristics of the CO, guiding them toward a favorable decision. These AI-generated recommendations are based on an analysis of the CO's behavior within the digital space.

To implement the experiment, we propose using the Meta Ads platform, which enables the application of artificial intelligence to generate recommendations and optimize ad campaigns targeted at potential customers. This tool has a significant impact on digital advertising trends and is frequently employed by marketers to execute digital ad campaigns.

This approach allows for a structured examination of how AI-driven recommendations can shape

consumer behavior and optimize marketing outcomes in a controlled, measurable setting.

The Meta Ads platform is selected for this study due to its widespread popularity and robust AI capabilities, notably its Meta Advantage+ tool, which makes it a significant subject for analyzing the influence on user behavior and decision-making.

Meta Ads employs various machine learning algorithms and intelligent technologies to analyze user data and identify behavioral patterns and trends. It gathers information on user interests, demographics, and past actions to develop personalized recommendations aimed at managing the behavior of economic agents (i.e., users of the digital space).

Additionally, through its built-in artificial intelligence, Meta Ads enables:

- ◆ the use of optimal ad layouts and platforms, allowing for efficient budget allocation;
- ◆ automatic selection of the most effective platform applications to display ads to the appropriate audience;
- ◆ audience targeting based on the likelihood of performing the desired action, among other functions.

In this experiment, the marketing specialist who configures the ad campaign on Meta Ads acts as the control subject. The goal is to maximize the number of target actions from a defined audience of potential clients, with each economic agent acting as the control object. Through interactions with AI tools, the marketing specialist receives recommendations and ready-made solutions to optimize advertising in social media. It is anticipated that these AI-generated recommendations will enhance the likelihood of potential clients interacting with the ads by influencing the factors involved in their decision-making mechanisms – their reflexive characteristics.

This setup highlights the interaction of economic agents in the digital space, where automated AI systems are used by the control subject (CS) and AI influences the control actions formulated by the CS [36].

To assess the effectiveness of using AI-generated recommendations from Meta Ads during ad campaign launches, an experiment with two test groups is proposed. In the first group, the ad campaign will be created solely by the marketing specialist without any AI recommendations. In the second group, the ad campaign will be modified according to the recommendations provided by AI.

For an objective comparison, both groups will use identical ad layouts.

The goal of the experiment is to compare the final outcomes of the two ad groups. If the ad campaigns incorporating AI recommendations lead to an increase in target actions by potential clients, it can be concluded that the use of AI in ad campaigns improves their effectiveness.

One unique aspect of advertising on Meta Ads, also known as “targeted advertising” (target – goal), is that it displays to specific users within the designated target audience, integrated directly into their social media news feeds without a prior request. Users may have shown interest in similar topics before, but at the time they see the Meta Ads, they are not necessarily intending to purchase a product or service. By analyzing the preferences, interests, and prior actions of potential clients, Meta Ads AI suggests personalized recommendations that most effectively capture the attention of digital users and influence their decision to perform the target action. Thus, one of the reflexive characteristics of the potential client, expected to change through interaction with the ad, is intention. Intention reflects the interest level and goal orientation of the potential client and their degree of willingness to perform the target action [36, 43].

Meta Ads allows the measurement of potential clients’ intention using metrics such as reach, total unique clicks, unique clicks on the link, views of the landing page, and website conversions.

In addition, the reflexive characteristic of the frequency of potential clients’ interaction with the ad is measurable. This is defined within the study as the intensity of interaction with the digital space. For interactions with Meta Ads, this can

be determined through metrics like impressions, total clicks, unique clicks on the link, and interactions with the post.

The level of competence and awareness of economic agents will be considered a constant for specific target groups. Using the settings in the Meta Ads advertising cabinet, such as “demographic characteristics” and “interests,” potential clients can be categorized as either “competent” or “incompetent” within the scope of the studied area. Other ways to define the level of competence and awareness of the object of management (OM) could include analyzing the interests and previous actions of the target audience.

For the group of ad campaigns launched without AI recommendations, basic manual targeting settings in Meta Ads can be used, such as age and geographic location (i.e., client location).

For ad campaigns with AI recommendations, we will use the built-in AI tool Meta Advantage+ for campaign optimization. In this case, the marketing specialist (MS) interacts with the AI tool and applies control measures based on AI recommendations, aiming to prompt a target action from the potential client (PC) after viewing the ad.

Thus, the experiment is conducted according to the following algorithm of actions:

1. According to the company’s marketing strategy, the characteristics of the industry, and the product being advertised, the target audience is divided into groups based on common reflexive characteristics – competence and awareness. For each group, the characteristics that will be used to set up the advertising campaign are described: age, geographic location, and interests. For each formed group of agents, a separate advertising campaign is created in the Meta Ads advertising cabinet, and the defined demographic, geographic, and interest-based settings are applied.

2. For each created advertising campaign, the same advertising materials are uploaded, and two groups of ads are launched. The first group of ads is launched with manual settings, while the second group includes settings recommended by the Meta Advantage+ AI. The advertising campaigns

are launched simultaneously and monitored over the same period of time.

3. The results of the advertising campaign are collected from the provided Meta Ads metrics, and the metrics are recorded for further determination of the reflexive characteristics of “intention” and “interaction intensity with the digital space,” as well as the calculation of the reflexive choice function values that determine the behavior of agents in the digital space [36, 40, 42]. To define the components of the reflexive choice function, the relevant data should be collected (Table 1).

The collected and grouped numerical data from Meta Ads metrics are normalized using the min-max scaling formula (1) and processed using Kohonen maps, following the methodology described in [36, 39].

$$x_{i \text{ norm}}^k = \frac{x_i^k - x_{i \text{ min}}^k}{x_{i \text{ max}}^k - x_{i \text{ min}}^k}, \quad (1)$$

where $x_{i \text{ max}}^k$ is the maximum possible value of the characteristic x_i^k , $x_{i \text{ min}}^k$ is the minimum possible value of the characteristic x_i^k , i is the index of the consumer group; and $k = \overline{1, K}$ is the index of the obtained parameter.

The use of Kohonen maps enables the determination of the reflexive characteristics of potential customers – namely, their **intention** and **interac-**

tion intensity with the digital space – within the clusters formed by the input data of the controlled objects (CO). The processing results obtained from Kohonen maps, specifically the average characteristic values within clusters, are interpreted as the identified reflexive characteristics of “intention” and “interaction intensity with the digital space” [36, 39, 42].

1. Based on the obtained values of agents’ reflexive characteristics, the predictive number of agents in the target state is calculated using the reflexive choice function (Equation 2). This methodology relies on the reflexive choice function rooted in V. Lefebvre’s mathematical approach to modeling agents’ behavior [44, 45]. Lefebvre’s model incorporates agents’ awareness of their own thoughts as well as their perceptions of the thoughts of other subjects. Consequently, reflexivity – defined through the agent’s level of awareness, competence, intention, and interaction intensity with the digital space – plays a pivotal role in modeling human behavior.

The premises and detailed modeling frameworks for the choice behavior of economic agents, utilized in this study, are comprehensively justified and outlined in the works of S. S. Turlakova [36, 39] and Ya. M. Shumilo [34, 35].

Thus, this study uses simple equations to forecast behavior, with parameters representing:

Table 1. Data that Are Necessary for Determining the Reflexive Characteristics

Reflexive characteristic to be defined	Data on which the reflexive characteristic is defined
Intention	Values of Meta Ads metrics: Reach; Unique clicks (all); Unique clicks on the link; Views of the landing page; Number of conversions on the site
Interaction Intensity with the Digital Space	1. Values of Meta Ads metrics, including; 2. The ratio of the listed metrics to the Meta Ads metric “Reach”
Awareness	[0; 1], where 0 means “uninformed” and 1 means “informed,” according to the groups formed in Step 1 of the algorithm
Competence	[0; 1], where 0 means “incompetent” and 1 means “competent,” according to the groups formed in Step 1 of the algorithm

- ◆ **The impact of the digital space on the subject,**
- ◆ **The subjective perception of this impact,** and
- ◆ **The subject's intention.**

The output of the reflexive choice function represents the probability that the controlled object will undertake a specific action. Furthermore, the decision-making of the controlled object (CO) in this study entails performing a target action, with the controlled subject (CS) attempting to influence the CO to select one of two alternatives: either perform the target action in response to the advertisement or abstain from doing so.

Consequently, the reflexive choice function will have the following form (Equation 2) [44, 45]:

$$X_{1j} = x_{1j} + (1 - x_{1j})(1 - x_{2j}) x_{3j}, \quad (2)$$

where $x_{1j}, x_{2j}, x_{3j} \in [0; 1], j = 1, M, M \leq N$; X_{1j} is the probability that represents the likelihood that the controlled object (CO) will choose an alternative favorable to the controlled subject (CS) in reality; x_{1j} is the probability that the CO perceives the pressure from the CS to select alternative 1 as equal to 1 at the moment of decision-making. This is determined by the intensity of interaction within the digital space, defined as $x_{2j} = \omega_i$; x_{2j} is the probability that the CO expects the pressure to choose alternative 1, favorable to the CS, to equal 1 based on prior decision-making experiences. This is determined by the product of the CO's **awareness** and **competence** $x_{1j} = \alpha_{jt} \cdot \gamma_{jt}$.

Here, the level of awareness of an agent at time t is represented by parameter α_{jt} that which may evolve over time depending on the information accessible to the agent. Similarly, the competence γ_{jt} : x_{3j} is the probability that the CO's evaluation of their intention to choose alternative 1 during the decision-making process equals 1. This reflects the CO's desire to make such a choice, with higher intention values x_{3j} indicating stronger motivation. The intention is defined as $x_{3j} = v_{jt}$.

Let us assume that the choice of the CO is intentional, meaning that the subjective intention of the CO always corresponds to the objective readiness to make a choice. In this case, the cognitive decision-making mechanism of the CO ad-

justs the values of X_{1j} and x_{3j} in such a way that the equality $X_{1j} = x_{3j}$ is satisfied [44, 45].

Under this assumption, Equation (4.11) takes the following form:

$$X_{1j} = x_{1j} + (1 - x_{1j})(1 - x_{2j}) X_{1j}. \quad (3)$$

In this case, the solution of equation (3) is as follows:

$$X_{1j} = \begin{cases} \frac{x_{1j}}{x_{1j} + x_{2j} - x_{1j}x_{2j}}, & \text{if } x_{1j} + x_{2j} > 0, \\ \text{any number from } [0; 1], & \text{if } x_{1j} = 0, x_{2j} = 0. \end{cases} \quad (4)$$

1. The goal of management in this experiment is defined as maximizing the achieved outcome, specifically achieving a reflexive choice function value greater than 0.8 [39, 41], unless the specifics of the subject area suggest a different threshold. If the management goal is not achieved, the experiment may continue with modifications in the formation of agent groups or adjustments to the advertising materials.

Following the established algorithm and methodology, an experiment has been conducted to study the impact of AI tools on the effectiveness of advertising campaigns using Meta Ads as a case study. The experiment involved analyzing the results of advertising campaigns for selling a real estate property by a developer company.

In this experiment, Meta Ads campaigns are created for two target groups of potential clients to promote the *Mezhyhirsky Townhouse*, a product of the developer company *Starhorod* Real Estate Agency LLC.

According to the defined marketing strategy of *Starhorod* Real Estate Agency LLC, the target audience (TA) for this real estate property included individuals aged 25–60 residing near the townhouse location – in Kyiv and Kyiv Oblast. It has been determined that the conditionally “competent” and “informed” group among potential clients consists of investors and real estate professionals (“realtors”). The second group comprises “incompetent” potential clients – real estate buyers from the target audience without professional experience in the field.

Separate advertising campaigns have been created for both identified agent groups, “competent” and “incompetent.” Each advertising campaign includes two groups of ads. The first group of ads is launched using manual settings only, while the second incorporates all the settings suggested by the built-in AI tool, Meta Advantage+.

The audience parameters set for the advertising campaign groups are detailed in Table 2.

Thus, four groups of ads are created and launched: “Incompetent – AI Settings”, “Incompetent – Manual Settings,” “Competent – AI Settings,” and “Competent – Manual Settings.” Identical advertising materials are uploaded for each group. The advertising campaigns are launched simultaneously, run in parallel, monitored over a one-month period.

Within the scope of the experiment in this subject area, the reflexive characteristics “awareness”

Table 2. Parameters of the Advertising Campaign Audience in the Current Experiment

Advertising campaign	“Competent”	“Incompetent”
Location of the audience	Ukraine, Kyiv Oblast, Kyiv +25 km	Ukraine, Kyiv Oblast, Kyiv +25 km
Age of the audience	25–55	30–60
Minimum age of the audience	25	25
Gender of the audience	Persons of Any Gender	Persons of Any Gender
Interests of the audience	“Real Estate,” “Development,” “Investments or Construction,” Position: “Realtor”	“Outdoor Recreation,” “Home Improvement,” “Children,” “Home or Family”

Table 3. Grouped Meta Ads Metrics Based on the Results of the Advertising Campaign, According to the Reflexive Characteristic “Intention”

Characteristic	Reach	Unique clicks (all)	Unique link clicks	Target page views	Website conversions
Manual settings					
Competent	4935	286	194	171	3
Incompetent	6195	396	288	262	8
AI settings					
Competent	6220	355	328	292	3
Incompetent	6264	325	289	261	9

Table 4. Grouped Meta Ads Metrics Based on the Results of the Advertising Campaign, According to the Reflexive Characteristic “Intensity of Interaction with the Digital Space”

Characteristic	Impressions	Total clicks (all)	Link clicks	Post engagements (all)
Manual settings				
Competent	5866	349	208	215
Incompetent	7347	508	310	318
AI settings				
Competent	8519	400	355	365
Incompetent	7992	360	289	322

and “competence” are defined as follows for the competent agent groups: competence $\alpha_{jt} = 1$, awareness $\gamma_{jt} = 0$.

For the incompetent agent groups: competence $\alpha_{jt} = 0$, awareness $\gamma_{jt} = 0$.

Thus, “competent” clients are those with certain experience, knowledge, awareness, and qualifications in matters related to purchasing real estate, while “incompetent” clients lack sufficient knowledge in this area.

The results of the advertising campaign are collected from the provided Meta Ads metrics and grouped according to the reflexive characteristics of “intention” and “interaction intensity with the digital space” (see Tables 3 and 4).

To ensure the comparability of the obtained metrics in further calculations, the ratio of the obtained data to the reach of each group has been calculated and linearly normalized within the range [0–1] according to formula (1).

The results of the data normalization are presented in Tables 5 and 6.

For clarity, the obtained data are presented in the form of diagrams (Fig. 1, Fig. 2), where 1 represents the “Manual-Competent” group, 2 represents the “AI-Competent” group, 3 represents the “Manual-Incompetent” group, and 4 represents the “AI-Incompetent” group.

The normalized data for determining the reflexive characteristics “Intention” and “Intensity of Interaction with the Digital Space” (Table 5) have been processed using Kohonen maps (Fig. 3, a, b).

As a result of processing the data using Kohonen maps for intention, all groups are assigned to separate clusters. However, when processing the data for determining the “Interaction Intensity with the Digital Space” characteristic using Kohonen maps, the user groups “Manual-Incompetent” and “Manual-Competent” end up in the same cluster, and therefore receive identical average values.

Table 5. Normalized Data Values According to the Reflexive Characteristic “Intention”

Characteristic	Unique clicks (all) / Reach	Unique link clicks / Reach	Target page views / Reach	Website conversions / Reach
Manual settings				
Competent	0.504174	0	0	0.13158
Incompetent	1	0.5348	0.62154	0.84765
AI settings				
Competent	0.431123	1	1	0
Incompetent	0	0.50854	0.57066	1

Table 6. Normalized Data Values According to the Reflexive Characteristic “Intensity of Interaction with the Digital Space”

Characteristic	Impressions / Reach	Total clicks (all) / Reach	Link clicks / Reach	Post engagements (all) / Reach
Manual settings				
Competent	0.01468	0.54007	0	0
Incompetent	0	1	0.52877	0.51374
AI settings				
Competent	1	0.27873	1	1
Incompetent	0.48953	0	0.26723	0.51858

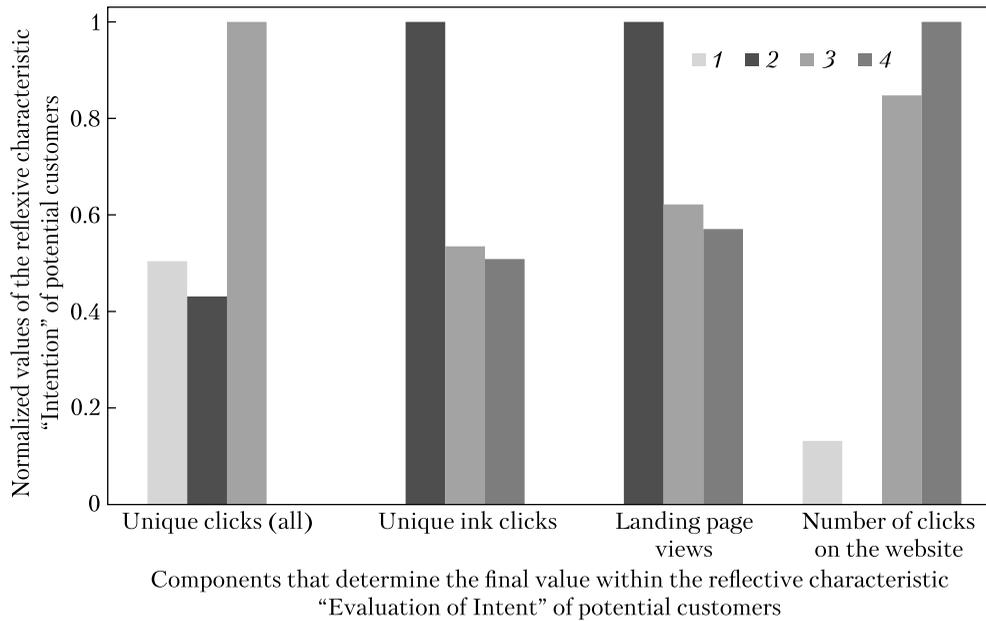


Fig. 1. Comparison diagram of the advertising campaign results of the experiment according to the reflexive characteristic "Intention" of potential clients

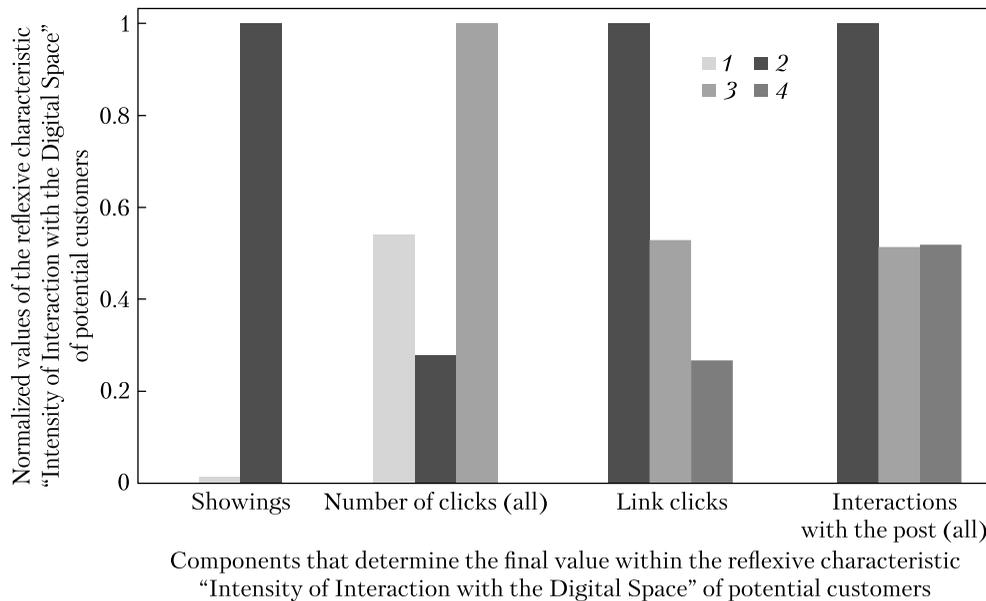


Fig. 2. Comparison diagram of the advertising campaign results of the experiment according to the reflexive characteristic "Intensity of Interaction with the Digital Space"

The obtained average values for the cluster indicators for determining the reflexive characteristics "Intention" and "Interaction Intensity with

the Digital Space" (Table 5, Table 6) are presented in Table 7 for further calculations related to the determination of the reflexive choice functions.

Thus, based on the obtained results, the predicted values of the reflexive choice function have been calculated using the reflexive choice function (2) for the agent groups. The calculation results are presented in Table 8.

Thus, the AI recommendations are able to influence the behavior of the “competent” agent group, showing higher effectiveness (0.82) of such advertising, as compared with the manual settings (0.32). For the “incompetent” group of clients, however, the AI recommendations turn out to be ineffective (0.67), as compared with the manual settings (0.83).

With the established management goal value of $C \geq 0.8$, it has been determined that the most effective approach to achieving this goal is the use of AI settings for influencing “competent” clients and manual settings for influencing “incompetent” clients. Therefore, the management goal has been achieved, and the experiment can be concluded.

By comparing the results of the experiment, it has been concluded that the use of AI recommendations will increase the advertising effectiveness for “competent” client groups, while interaction with “incompetent” client groups is more effective with manual settings (Fig. 4).

Here, “competent” clients are considered to be those knowledgeable about the subject matter of the study, specifically real estate investors, realtors, and other users interested in real estate and construction topics. “Incompetent” clients are deemed to be users of the digital space who are part of the target audience of the product according to the marketing strategy, but have not explored it – young families, families with children who potentially needed more living space or are interested in suburban leisure.

It can be hypothesized that such a result is observed due to emotional decision-making rather than logical reasoning by clients with a low level of competence and awareness. Thus, it can be concluded that, at present, artificial intelligence does not possess sufficiently developed empathy – the ability to recognize, understand, and adapt to the emotions or state of the user.

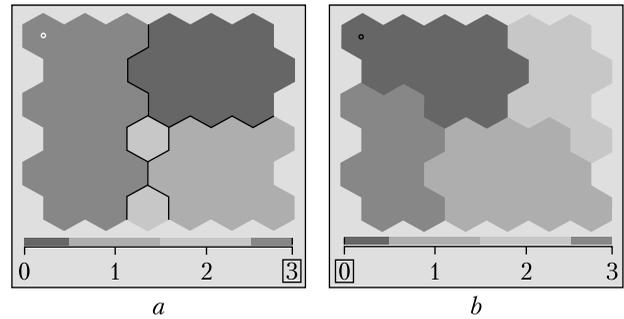


Fig. 3. Results of processing normalized data for determining clusters and corresponding values of reflexive characteristics “Intention” (a) and “Intensity of Interaction with the Digital Space” (b) for potential clients

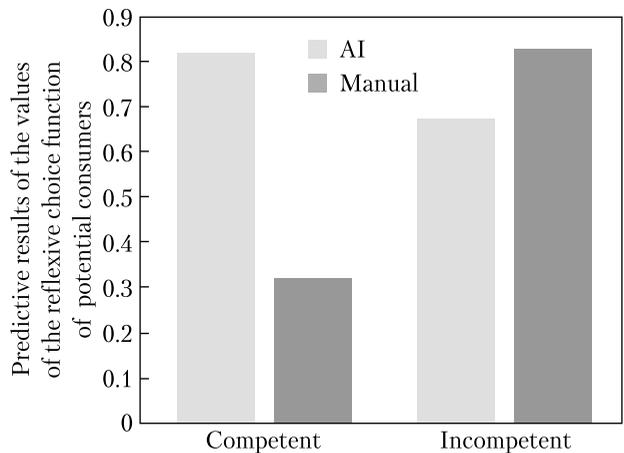


Fig. 4. Comparative diagram of predicted reflexive choice function results for “Competent” and “Incompetent” consumers in advertising campaigns with Manual Settings and AI Settings

The results of the study allow the following conclusions:

The use of AI tools in the digital space influences the behavior of economic agents and can change the outcome of decision-making.

The use of AI recommendations on the Meta Ads platform increases the likelihood of achieving the marketing specialist’s management goal. Specifically, it helps advertisers gain more profit by increasing the number of products sold and improves the return on marketing investments when interacting with competent and informed potential clients.

The use of AI recommendations enables greater reach to potential clients across all audience groups simultaneously.

The use of AI recommendations leads to a higher percentage of clicks on links and views of the landing page. This is particularly significant for advertising campaigns where the goal is to drive traffic and conversions on the company’s website.

AI recommendations improve the effectiveness of Meta Ads campaigns, with the best results achieved when targeting competent and informed economic agents.

The approaches proposed in this study can be applied in the marketing activities of companies that attract potential clients from the digital space through targeted advertising and can group the target audience by reflexive characteristics such as “awareness” and “competence.” Typically, these are businesses whose clients include both legal entities (B2B market) and individuals (B2C market) [46]. The results of the study can be extrapolated for a general understanding by marke-

ting specialists of the impact of using artificial intelligence tools in Meta Ads campaigns.

The overall economic effect from the implementation of the scientific developments proposed in this article into the business practice of managing the behavior of economic agents in the digital space is expected to come from ensuring the manageability of potential clients’ behavior using reflexive management methods, taking into account Meta Ads recommendations. This will help ensure the necessary level of demand for the company’s products in line with the enterprise’s marketing strategy goals. It is also worth noting the potential for increasing the social impact of using Meta Ads’ artificial intelligence tools in the implementation of digital marketing campaigns by ensuring that potential clients receive advertisements that match their interests.

Undoubtedly, the predicted results of this experiment need to be compared with the actual sales results the company will achieve after the completion of such advertising campaigns. A promising direction for further research is also the analysis of potential risks associated with the use of artificial intelligence tools in marketing activities and, in particular, in advertising campaigns.

Table 7. Obtained Average Values of Reflexive Characteristics for Agent Groups

Ad groups	Intention	Intensity of interaction with digital space
AI-competent	0.6075	0.82
AI-incompetent	0.5175	0.3175
Manual-competent	0.1575	0.32425
Manual-incompetent	0.75	0.32425

Table 8. Obtained Predicted Values of the Reflexive Choice Function for Agent Groups

Ad groups	Projected value
AI-competent	0.82
AI-incompetent	0.67
Manual-competent	0.32
Manual-incompetent	0.83

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REFERENCES

1. Bean, R. (2018). How Big Data and AI Are Driving Business Innovation in 2018. URL: <https://sloanreview.mit.edu/article/how-big-data-and-ai-are-driving-business-innovation-in-2018/> (Last accessed: 16.08.2024).
2. Miller, S. (2018). AI: Augmentation, more so than automation. *Asian Management Insights*, 5(1), 1–20. URL: <https://ink.library.smu.edu.sg/ami/83> (Last accessed: 16.08.2024).
3. McKinsey & Company. (2023). The state of AI in 2023: Generative AI's breakout year. URL: <https://www.mckinsey.com/capabilities/quantumblack/our-insights/the-state-of-ai-in-2023-generative-ais-breakout-year#research> (Last accessed: 16.08.2024).
4. Forbes. (2023). AI in Business. URL: <https://www.forbes.com/advisor/business/software/ai-in-business/> (Last accessed: 01.12.2023).
5. Daugherty, P. R., Wilson, H. J. (2018). *Human+ Machine: Reimagining Work in the Age of AI*: Harvard Business Press.
6. Agrawal, A., Gans, J., Goldfarb, A. (2018). *Prediction Machines: The simple economics of artificial intelligence*: Harvard Business Press.
7. Panetta, K. (2018). Gartner Top 10 Strategic Technology Trends for 2018. URL: <https://www.gartner.com/smarterwithgartner/gartner-top-10-strategic-technologytrends-for-2018/> (Last accessed: 01.12.2023).
8. Li, H. (2019). Special Section Introduction: Artificial Intelligence and Advertising. *Journal of Advertising*, 48(4), 333–337. <https://doi.org/10.1080/00913367.2019.1654947>
9. Shumanov, M., Cooper, H., Ewing, M. (2021). Using AI predicted personality to enhance advertising effectiveness. *European Journal of Marketing*. <https://doi.org/10.1108/EJM-12-2019-0941>
10. Shumilo, Y. M. (2022). Possibilities and advantages of using artificial intelligence tools in digital marketing activities. In: *Commercialization of Innovations: Protection of Intellectual Capital, Marketing, and Innovations* (monograph) (Eds. Sager L.Yu., Sihydi L.O.). Sumy [in Ukrainian].
11. Shumilo, Y. M. (2022). Artificial intelligence tools for managing the behavior of economic agents in marketing activities. *Bulletin of V.N. Karazin Kharkiv National University. Series: International Relations. Economics. Country Studies. Tourism*, 15, 60–68. <https://doi.org/10.15407/scin13.05.019>. [in Ukrainian]
12. Bačík, R., Fedorko, R., Kakalejčík, L., Pudlo, P. (2015). The importance of Facebook Ads in terms of online promotion. *Journal of applied economic sciences*, 10(5), 35. URL: <https://www.ceeol.com/search/article-detail?id=537100> (Last accessed: 16.08.2024).
13. Srinivasan, D. (2020). Why Google dominates advertising markets. *Stanford Technology Law Review*, 24, 55. URL: <https://heinonline.org/HOL/LandingPage?handle=hein.journals/stantlr24&div=4&id=&page=> (Last accessed: 16.08.2024).
14. Proskurnina, N. V., Dobroskok, Yu. B. (2019). Artificial intelligence in marketing activities of trade enterprises. *Economic development and heritage of Semen Kuznets: materials of the International science and practice conference, (30–31, May, 2019, Kharkiv)*, 254–255. Kharkiv [in Ukrainian]
15. Khrupovych, S. Ye., Borysova, T. M. (2021). Using artificial intelligence in marketing analysis of unstructured data. *Marketing and digital technology*, 5(1), 17–26. URL: <https://elartu.tntu.edu.ua/handle/lib/41207> (Last accessed: 16.08.2024) [in Ukrainian].
16. Khrupovych, S. E., Okrepkyi, R. B., Dudar, V. T. (2022). Using artificial intelligence to model the consumer portrait in digital marketing. *Galician Economic Herald*, 74(1), 163–170. URL: <https://elartu.tntu.edu.ua/handle/lib/41207> (Last accessed: 16.08.2024) [in Ukrainian].
17. Korsunova, K. Y. (2022). The impact of artificial intelligence on international digital marketing. *Bulletin of the Volodymyr Dahl East Ukrainian National University*, 4(274), 25–30. URL: https://doi.org/10.33108/galicianvisnyk_tntu2022.0 (Last accessed: 16.08.2024) [in Ukrainian].
18. Haleem, A., Javaid, M., Qadri, M. A., Singh, R. P., Suman, R. (2022). Artificial intelligence (AI) applications for marketing: A literature-based study. *International Journal of Intelligent Networks*. <https://doi.org/10.33216/1998-7927-2022-276-6-13-19>

19. Boddu, R. S. K., Santoki, A. A., Khurana, S., Koli, P. V., Rai, R., Agrawal, A. (2022). An analysis to understand the role of machine learning, robotics and artificial intelligence in digital marketing. *Materials Today: Proceedings*, 56, 2288–2292. <https://doi.org/10.1016/j.matpr.2021.11.637>
20. Rathore, B. (2023). Digital Transformation 4.0: Integration of Artificial Intelligence & Metaverse in Marketing. *Eduzone: International Peer Reviewed/Refereed Multidisciplinary Journal*, 12(1), 42–48. URL: https://www.researchgate.net/profile/Bharati-Rathore-2/publication/368789565_Digital_Transformation_40_Integration_of_Artificial_Intelligence_Metaverse_in_Marketing/links/63f9d19d0d98a97717b8350e/Digital-Transformation-40-Integration-of-Artificial-Intelligence-Metaverse-in-Marketing.pdf (Last accessed: 16.08.2024).
21. Kopalle, P. K., Gangwar, M., Kaplan, A., Ramachandran, D., Reinartz, W., Rindfleisch, A. (2022). Examining artificial intelligence (AI) technologies in marketing via a global lens: Current trends and future research opportunities. *International Journal of Research in Marketing*, 39(2), 522–540. <https://doi.org/10.1016/j.ijresmar.2021.11.002>
22. Hermann, E. (2022). Leveraging artificial intelligence in marketing for social good – An ethical perspective. *Journal of Business Ethics*, 179(1), 43–61. <https://doi.org/10.1007/s10551-021-04843-y>
23. Atanasov, V. (2020). *Digital Capitalism and Internet Utopias*. Kyiv [in Russian].
24. Zuboff, S. (2019). *The Age of Surveillance Capitalism*. New York.
25. Dyer-Witheford, N., Kjøsen, A. M., Steinhoff, J. (2019). *Inhuman Power: Artificial Intelligence and the Future of Capitalism*. London. <https://doi.org/10.2307/j.ctvj4sxc6>
26. Steinhoff, J. (2021). *Automation and Autonomy Labour, Capital and Machines in the Artificial Intelligence Industry*. Marx, Engels, and Marxisms. Palgrave Macmillan, Cham. Washington. <https://doi.org/10.1007/978-3-030-71689-9>
27. Thaler, R. H. (2015). *Misbehaving: The story of behavioral economics*. New York. Norton & Company, Incorporated.
28. Sunstein, C. R., Thaler, R. H. (2008). *Nudge: Improving decisions about health, wealth, and happiness*. New Haven. Yale University Press.
29. Thaler, R. H., Ganser, L. J. (2015). Misbehaving: The Making of Behavioral Economics. *The Review of Austrian Economics*, 30(1), 137–141. <https://doi.org/10.1007/s11138-015-0330-z>
30. Arrow, K. J. (1973). *Information and Economic Behavior*. Fort Belvoir. <https://doi.org/10.21236/ad0768446>
31. Novikov, D. A. (2014). *Reflexion and Control: Mathematical Models*. London.
32. Chkhartishvili, A. G., Gubanov, D. A., Novikov, D. A. (2018). *Models of Influence in Social Networks. In Social Networks: Models of Information Influence, Control and Confrontation*. Springer International Publishing. https://doi.org/10.1007/978-3-030-05429-8_1
33. Korepanov, V. O., Chkhartishvili, A. G., Shumov, V. V. (2022). Game-theoretic and reflexive combat models. *Computer Research and Modeling*, 14(1), 179–203. <https://doi.org/10.20537/2076-7633-2022-14-1-179-203>
34. Mints, A., Kamyshnykova, E., Zherlitsyn, D., Bukrina, K., Bessonova, A. (2021). Corporate Social Responsibility Impact on Financial Performance: a Case for the Metallurgical Industry. *WSEAS Transactions on Environment and Development*, 17(39), 398–409. <https://doi.org/10.37394/232015.2021.17.39>,
35. Mints, A., Schumann, A., Kamyshnykova, E. (2020). Stakeholders' rank of reflexion diagnostics in a corporate social responsibility system. *Economic Annals-XXI*, 181(1–2), 92–104. <https://doi.org/10.21003/ea.V181-08>
36. Turlakova, S. S. (2022). Conceptual provisions for managing the behaviour of economic agents in the digital space using artificial intelligence tools. *Economics and entrepreneurship*, 49, 40–54. <https://www.doi.org/10.33111/EE.2022.49.TurlakovaS> [in Ukrainian].
37. Shumilo, Y. M. (2023). Reflective management of the behaviour of marketing specialists using artificial intelligence tools. In: *Actual problems of system analysis and modelling of management processes* (monograph) (Eds. V. Ponomarenko, L. Guryanova, J. Peliova, E. Nizhynsky). Bratislava [in Ukrainian].
38. Stashkevych, I., Turlakova, S., Shevchenko, O., Derzhetska, M. (2020). IDEFO-Technology of Modeling of Processes of Minimization the Resistance of the Personnel to Organizational Changes at the Enterprise. *WSEAS Transactions on Environment and Development*, 16, 286–296. <https://doi.org/10.37394/232015.2020.16.30>
39. Turlakova, S., Vyshnevskiy, O., Lohvinenko, B., Fomichenko, I. (2020). Role of Reflexive Characteristics of Agents in the Level of Consistency of Goals in the Group. *WSEAS Transactions on Environment and Development*, 16, 297–304. <https://doi.org/10.37394/232015.2020.16.31>
40. Turlakova, S., Lohvinenko, B. (2023). Artificial intelligence tools for managing the behavior of economic agents at micro level. *Neuro-Fuzzy Modeling Techniques in Economics*, 12, 3–39. <http://doi.org/10.33111/nfmte.2023.003>
41. Turlakova, S. S. (2022). Modeling the values of reflexive characteristics of agents within the management of herd behavior at the enterprises. *Neuro-Fuzzy Modeling Techniques in Economics*, 11, 48–77. <http://doi.org/10.33111/nfmte.2022.048>

42. Shumilo, Y. M. (2023). *Reflexive management of the behavior of marketing specialists with the help of artificial intelligence tools. Actual problems of system analysis and modeling of management processes: monograph.* (Eds. V. Ponomarenko, L. Guryanova, Ya. Peliova, E. Nizhynskyi). Bratislava-Kharkiv.
43. Shumilo, Y. M. (2022). Conceptual provisions of the mechanism of reflexive management of consumer behaviour in the marketing activities of enterprises. *Economics of Industry*, 1(97), 103–117 [in Ukrainian]. <https://doi.org/10.15407/econindustry2022.01.103>
44. Lefebvre, V., Schwartz, R. (2014). An Empirical Ratio in Search of a Theory. *The American psychologist*, 69, 634–635. <http://doi.org/10.1037/a0036949>.
45. Lefebvre, V. (2017). Bipolar choice in the experimental chamber. *Bipolar Disord: Open Access*, 3(1), 115. <http://doi.org/10.4172/2472-1077.1000115>
46. Oleksiuk, O., & Shafalyuk, O. (2023). Management of pharmaceutical online retail through a regional marketplace with neural network and statistical analytical tools. *Neuro-Fuzzy Modeling Techniques in Economics*, 12, 155–174. <http://doi.org/10.33111/nfmte.2023.155>

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ВПЛИВ ІНСТРУМЕНТІВ ШТУЧНОГО ІНТЕЛЕКТУ НА УПРАВЛІННЯ ПОВЕДІНКОЮ СПОЖИВАЧІВ У ЦИФРОВОМУ МАРКЕТИНГУ

Вступ. Сьогодні в умовах стрімкого розвитку цифрових технологій інтернет-реклама стала невід'ємною складовою успішної комунікації між брендами та їхньою цільовою аудиторією у цифровому просторі.

Проблематика. Існує гіпотеза, що використання інструментів штучного інтелекту дозволяє збільшити результативність рекламних кампаній та, як наслідок, призводить до збільшення продажів товарів, зростання прибутку компанії-рекламодавця та підвищує рентабельність маркетингових інвестицій.

Мета. Дослідити вплив інструментів штучного інтелекту (ШІ) на управління поведінкою споживачів у цифровому маркетингу.

Матеріали й методи. Серед двох тестових груп проведено експеримент на платформі *Meta Ads* для порівняння результатів рекламних кампаній, налаштованих із застосуванням інструментів ШІ й ручними налаштуваннями. Виділено дві тестові групи рекламних кампаній відповідно компетентності та інформованості об'єктів управління. За допомогою карт Кохонена визначено значення рефлексивних характеристик об'єктів управління в тестових групах. Із використанням ручних налаштувань та інструментів ШІ проведено експеримент щодо зміни фахівцем з цифрового маркетингу рефлексивних характеристик потенційних клієнтів. Досліджено зміну поведінки потенційних клієнтів щодо виконання цільової дії рекламної кампанії та застосовано метод порівняння.

Результати. З'ясовано, що використання інструментів ШІ дозволяє вплинути на поведінку користувачів цифрового простору. Показано, що рекомендації штучного інтелекту дозволяються підвищити охоплення, кількість кліків та переходів за посиланням в оголошеннях. Найбільшої ефективності вони досягають при таргетуванні потенційних клієнтів. Окреслено перспективні напрями подальших досліджень.

Висновки. Застосування інструментів штучного інтелекту в рекламних кампаніях *Meta Ads* дозволить рекламодавцям отримати більший прибуток за рахунок збільшення кількості проданих товарів та підвищити рентабельність маркетингових інвестицій.

Ключові слова: штучний інтелект, інструменти штучного інтелекту, управління поведінкою, рефлексивне управління, цифровий простір, цифровий маркетинг, *Meta Ads*, результативність рекламних кампаній, маркетингові дослідження.