Examining the Relationship Between Social Media-Based Marketing Variables and Research and Development Policies

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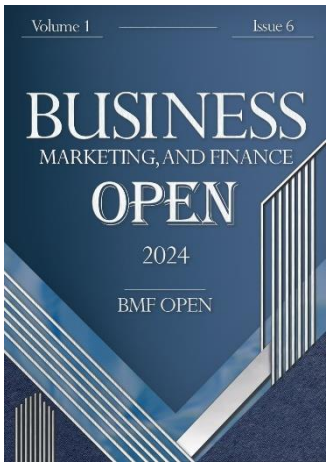

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Abstract: The present study aims to examine the relationship between social media-based marketing variables and research and development policies. The statistical population in the quantitative section consists of home appliance marketers across the country, and given its unlimited nature, the sample size was determined to be 384 individuals. The participants were selected using a simple random sampling method. A standardized questionnaire was used to measure the variables. The validity of the questionnaire was assessed through confirmatory factor analysis, and its reliability was examined using Cronbach's alpha coefficient. The research model was tested based on the structural equation modeling method using PLS software. The results of data analysis indicated that business strategy factors have a significant impact on research and development policies. Supportive policy factors have a significant impact on research and development policies. Business investment factors have a significant impact on research and development policies. Infrastructure factors of businesses also have a significant impact on research and development policies. Additionally, the significant impact of customer factors, business transformation factors, knowledge capital, and technological factors on research and development policies was confirmed.

Keywords: Marketing variables, social media, research and development policies

1. Introduction

The advent of social media has profoundly transformed various aspects of modern society, including communication, education, and commerce. Among these changes, the role of social media in shaping marketing strategies and research and development (R&D) policies has gained increasing scholarly attention [1, 2]. Businesses, especially in competitive industries, have recognized the potential of social media platforms as crucial tools for engaging with consumers, gathering market intelligence, and influencing innovation strategies. Social media-based marketing enables companies to foster brand loyalty, expand customer outreach, and collect real-time feedback, which in turn informs strategic business decisions [3].

Recent research has emphasized the profound impact of social media on knowledge dissemination and research visibility. Astawa and Ulwi (2024) explored how social media facilitates the dissemination of research in humanities and social sciences, highlighting its role in accelerating knowledge exchange and fostering academic collaboration [2]. Similarly, Babka (2023) examined the influence of social media in R&D, demonstrating that digital platforms

enhance knowledge sharing and provide valuable insights into consumer behavior [4]. These findings underscore the significance of social media in shaping business strategies and guiding research priorities. Moreover, social media not only supports business intelligence but also serves as a platform for customer engagement, which can directly influence R&D decisions [1]. Given this context, the present study seeks to examine the relationship between social media-based marketing variables and R&D policies, contributing to the growing body of literature on digital marketing and innovation management.

While social media offers numerous advantages for businesses, its negative implications should not be overlooked. Studies have highlighted the adverse effects of social media on consumer behavior and societal well-being. For instance, Noori, Sayes, and Anwari (2023) discussed how excessive social media use negatively impacts social interactions, leading to a decline in meaningful face-to-face communication [5]. Similarly, Li (2024) and Kou (2024) examined the psychological effects of social media, revealing that prolonged engagement with digital platforms can contribute to loneliness, anxiety, and mental health challenges [6, 7]. These concerns are particularly relevant for businesses that rely on social media marketing, as consumer engagement on these platforms may not always translate into positive outcomes for long-term brand loyalty. Additionally, studies by Mushthofa, Wathoni, and Daryono (2024) demonstrated that social media intensity mediates the influence of spiritual intelligence and Islamic learning on consumer behavior, further emphasizing the complex and multifaceted nature of social media interactions [8].

The intersection of social media and R&D policies has also been explored through the lens of organizational decision-making and investment strategies. Liyanto and Ainun (2024) analyzed the impact of corporate social media popularity on information asymmetry, finding that firms with strong social media presence tend to experience reduced asymmetry in financial disclosures [2]. This finding suggests that companies can leverage social media as a strategic tool to enhance transparency and stakeholder engagement, which in turn influences investment decisions in R&D. Similarly, Radjabova (2023) conducted a network analysis of social media research in entrepreneurship development, highlighting the role of digital platforms in fostering innovation and business growth [9]. These insights are crucial for understanding how social media-based marketing strategies can align with corporate R&D policies to drive innovation.

Beyond business applications, the broader societal implications of social media have also been extensively studied. He (2022) examined the impact of social media on teenagers, revealing that digital engagement shapes cognitive development and social interactions [10]. Similarly, Diniarti and Darraz (2024) investigated the negative effects of social media platforms like TikTok on ethical behavior, suggesting that unregulated content consumption can have long-term implications for personal and professional ethics [11]. Erma et al. (2022) further explored how social media contributes to societal conflicts, emphasizing the need for responsible digital engagement [12]. These findings highlight the importance of integrating ethical considerations into social media marketing strategies, ensuring that business practices align with societal well-being.

Furthermore, social media's influence extends to political and cultural domains. Yogapriya and Chettri (2022) examined the role of social media in political decision-making, demonstrating how digital platforms shape public opinion and electoral outcomes in developing countries [13]. Similarly, Pathan (2024) discussed the advantages and adversities of social media in social interactions, particularly in relation to cyberbullying and digital harassment [14]. These studies underscore the need for businesses to adopt responsible social media practices that consider the broader implications of digital marketing campaigns.

The integration of social media in business strategies is not limited to marketing but extends to knowledge commercialization and intellectual property management. Shi (2024) examined the impact of social media on education, revealing its potential to transform learning methodologies and facilitate knowledge sharing. These insights are particularly relevant for businesses that invest in R&D, as digital platforms can serve as valuable tools for disseminating innovation and fostering industry-academic collaborations [15].

While the benefits of social media-based marketing in shaping R&D policies are evident, there remains a need for empirical research that examines the direct relationship between these variables. Nugraha et al. (2024) investigated the impact of social media on social interaction and self-identity, demonstrating how digital engagement influences consumer perceptions and brand preferences [16]. Similarly, Purificacion and Vallespin (2024) analyzed the psychological, behavioral, and physiological dimensions of social media addiction, raising concerns about its long-term effects on consumer behavior [17]. These findings indicate that businesses must adopt a balanced approach in leveraging social media for marketing and R&D, ensuring that digital engagement strategies align with consumer well-being and ethical considerations.

In light of these discussions, the present study aims to bridge the gap in the literature by examining the relationship between social media-based marketing variables and R&D policies. By leveraging insights from prior research, this study seeks to contribute to the ongoing discourse on digital marketing and innovation management. Given the increasing reliance on social media for business decision-making, understanding its impact on R&D policies is essential for organizations striving to maintain competitiveness in the digital age. The findings of this study are expected to provide valuable implications for business leaders, policymakers, and academic researchers, offering a comprehensive framework for integrating social media strategies with innovation-driven policies.

2. Methodology

This study, considering its objective of presenting a social media-based marketing approach in research and development (R&D) policies using the CATWOE strategic framework in the home appliance industry in Iran, is entirely applied in nature. The results of this research can be utilized by relevant organizations and institutions. Furthermore, based on the method of data collection, this research is descriptive and entirely non-experimental, as it seeks to examine and describe the relationship between social media-based marketing and R&D policies. Lastly, given the use of a questionnaire and its implementation method, this study is classified as a survey. The statistical population consists of home appliance marketers across the country, and given its unlimited nature, the sample size was determined to be 384 individuals.

Content validity ensures that the measurement scale includes a sufficient set of items for assessing the variable. The purpose of validity in research is to confirm that the measurement instrument accurately captures the intended variable. The importance of validity lies in the fact that inappropriate or insufficient measurements can render any scientific research meaningless and unreliable (Khaki, 2020). In this study, the validity of the questionnaire was confirmed by the supervising professor and several experts. In general, the following methods were used to enhance the validity of the research instrument:

1. Incorporating the opinions of supervising and consulting professors, as well as management experts.
2. Reviewing articles, books, and journals that have utilized this questionnaire or similar questionnaires.
3. Conducting factor analysis using LISREL software.

To assess the reliability of the research variables, Cronbach's alpha test was applied. The procedure involved distributing 30 questionnaires within the study population, following the validation of the questionnaire by the supervising professor. The reliability was then assessed using SPSS 26 software.

Table 1 presents the Cronbach's alpha values for the research dimensions. The results indicate that all Cronbach's alpha values exceed 0.7, confirming the acceptable reliability of the research instrument.

Table 1. Cronbach's Alpha Coefficients for Research Components

No.	Components	Cronbach's Alpha
1	Business Strategy Factors	0.889
2	Supportive Policy Factors	0.881
3	Business Investment Factors	0.852
4	Business Infrastructure Factors	0.891
5	Global Business Perspective Factors	0.857
6	Customer Factors	0.852
7	Business Transformation Factors	0.849
8	Business Constraint Factors	0.851
9	Knowledge Capital	0.852
10	Technological Factors	0.886
11	Business Strategy Factors	0.859

3. Findings

In this study, 74% of the respondents were male, and 26% were female. Additionally, 28% of the respondents were single, while 72% were married. In terms of age distribution, individuals under 30 years old constituted the largest proportion of respondents at 35%, while those over 50 years old accounted for the smallest proportion at 8%. Finally, respondents with a bachelor's degree formed the largest group at 52%, whereas those with a doctoral degree comprised the smallest segment at 4%.

Subsequently, a descriptive analysis of the research variables is presented. To examine the status of these variables, descriptive indicators such as mean, standard deviation, variance, minimum, and maximum values were utilized. The results are provided in Table 2.

Table 2. Descriptive Statistics of Research Dimensions

Dimensions	Mean	Standard Deviation	Variance	Minimum	Maximum
Business Strategy Factors	3.180	0.796	0.635	1.00	5.00
Supportive Policy Factors	3.316	0.709	0.503	1.33	5.00
Business Investment Factors	3.503	0.704	0.497	1.56	5.00
Business Infrastructure Factors	3.451	0.688	0.474	1.45	5.00
Global Business Perspective Factors	3.261	0.769	0.592	1.11	5.00
Customer Factors	3.195	0.743	0.553	1.22	5.00
Business Transformation Factors	3.224	0.655	0.430	1.58	4.83
Business Constraint Factors	3.481	0.630	0.398	1.67	5.00
Knowledge Capital	3.590	0.748	0.560	1.33	5.00
Technological Factors	3.449	0.703	0.495	1.36	4.91
Research and Development	3.614	0.658	0.434	1.33	5.00

As shown in Table 2, the mean of business strategy factors is 3.180, with a standard deviation of 0.796, indicating that respondents perceive the level of business strategy factors to be above the average value (3).

The mean of supportive policy factors is 3.316, with a standard deviation of 0.709, indicating that respondents perceive the level of supportive policy factors to be above the average value (3).

The mean of business investment factors is 3.503, with a standard deviation of 0.704, indicating that respondents perceive the level of business investment factors to be above the average value (3).

The mean of business infrastructure factors is 3.451, with a standard deviation of 0.688, indicating that respondents perceive the level of business infrastructure factors to be above the average value (3).

The mean of global business perspective factors is 3.261, with a standard deviation of 0.769, indicating that respondents perceive the level of global business perspective factors to be above the average value (3).

The mean of customer factors is 3.195, with a standard deviation of 0.743, indicating that respondents perceive the level of customer factors to be above the average value (3).

The mean of business transformation factors is 3.224, with a standard deviation of 0.655, indicating that respondents perceive the level of business transformation factors to be above the average value (3).

The mean of business constraint factors is 3.481, with a standard deviation of 0.630, indicating that respondents perceive the level of business constraint factors to be above the average value (3).

The mean of knowledge capital is 3.590, with a standard deviation of 0.748, indicating that respondents perceive the level of knowledge capital to be above the average value (3).

The mean of technological factors is 3.449, with a standard deviation of 0.703, indicating that respondents perceive the level of technological factors to be above the average value (3).

The mean of research and development is 3.614, with a standard deviation of 0.658, indicating that respondents perceive research and development to be above the average value (3). The results show that the highest mean belongs to the research and development variable, while the lowest mean corresponds to economic factors. Similarly, the minimum and maximum values for this variable range from 1 to 5.

Before conducting the necessary tests for data analysis, it is essential to examine the normality of the data. There are several methods for testing normality, and in this study, skewness and kurtosis tests were used. These tests are recognized as statistically valid methods. The skewness statistic is less than 1 and close to zero, while the kurtosis statistic is less than 1.5, indicating that the data distribution is normal.

H_0: The variables under study have a normal distribution.

H_1: The variables under study do not have a normal distribution.

The results of the normality test are presented in Table 3.

Table 3. Results of Normality Test

Dimensions	Kurtosis	Skewness	Result
Business Strategy Factors	-0.144	-0.143	Normal
Supportive Policy Factors	-0.138	0.066	Normal
Business Investment Factors	-0.103	0.187	Normal
Business Infrastructure Factors	-0.199	-0.089	Normal
Global Business Perspective Factors	-0.111	-0.101	Normal
Customer Factors	-0.143	-0.132	Normal
Business Transformation Factors	-0.198	0.101	Normal
Business Constraint Factors	-0.276	0.077	Normal
Knowledge Capital	-0.176	0.132	Normal
Technological Factors	-0.173	-0.089	Normal
Research and Development	0.046	-0.098	Normal

If the skewness and kurtosis values fall between -2 and 2, the distribution is considered normal. As seen in the table above, all skewness and kurtosis values fall within this range. Therefore, there is no reason to reject the null hypothesis, and all research variables are normally distributed.

The Kaiser-Meyer-Olkin (KMO) test is used to measure statistical power and confirm the adequacy of the sample size before hypothesis testing. The KMO test determines whether the variance of research variables is influenced by common hidden factors. The test value ranges between 0 and 1, with the following interpretations:

- A value of 0.49 or lower: Factor analysis is not recommended.
- A value between 0.50 and 0.69: Factor analysis is recommended if data adjustments are made to improve suitability.
- A value of 0.70 or higher: Factor analysis is recommended.

The Bartlett's test of sphericity is also used to calculate the normalized chi-square. The term "sphericity" refers to the assumption that variance across variables is equal. In linear algebra, the identity matrix is a square matrix with ones on the main diagonal and zeros elsewhere.

A model is a statistical proposition about relationships between variables. Path analysis is a good example of a model, and model development is a structured approach to formally representing these relationships. This model illustrates independent and dependent variables using a path diagram. Independent variables are often referred to as exogenous variables, meaning their causes originate outside the model, whereas dependent variables are endogenous, meaning their causes are determined within the model. Model formulation includes specifying parameters that describe the relationships between constructs. The LISREL software evaluates the proposed model and provides the final model after analyzing the variables.

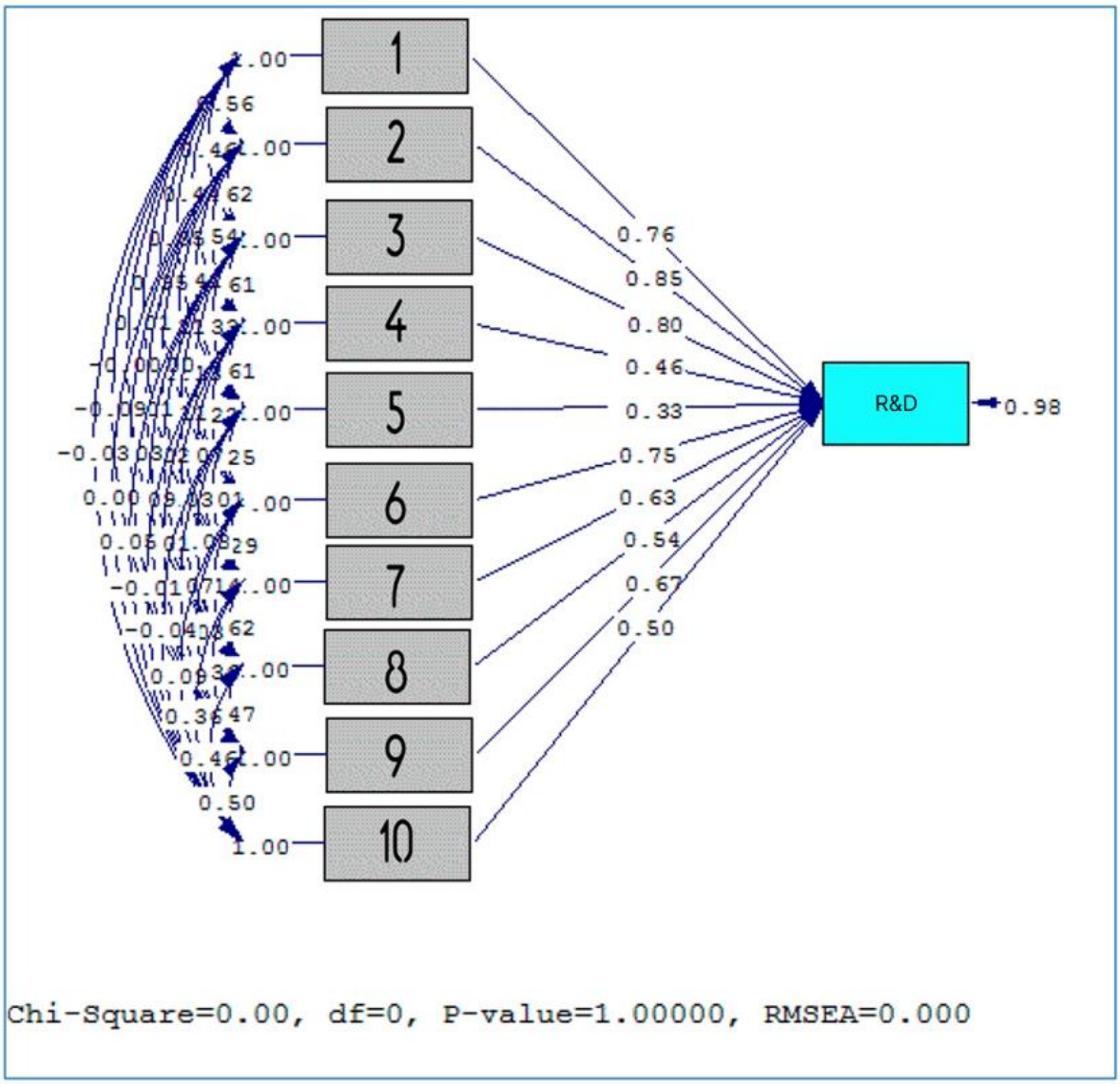

Figure 1. Standard Model Output

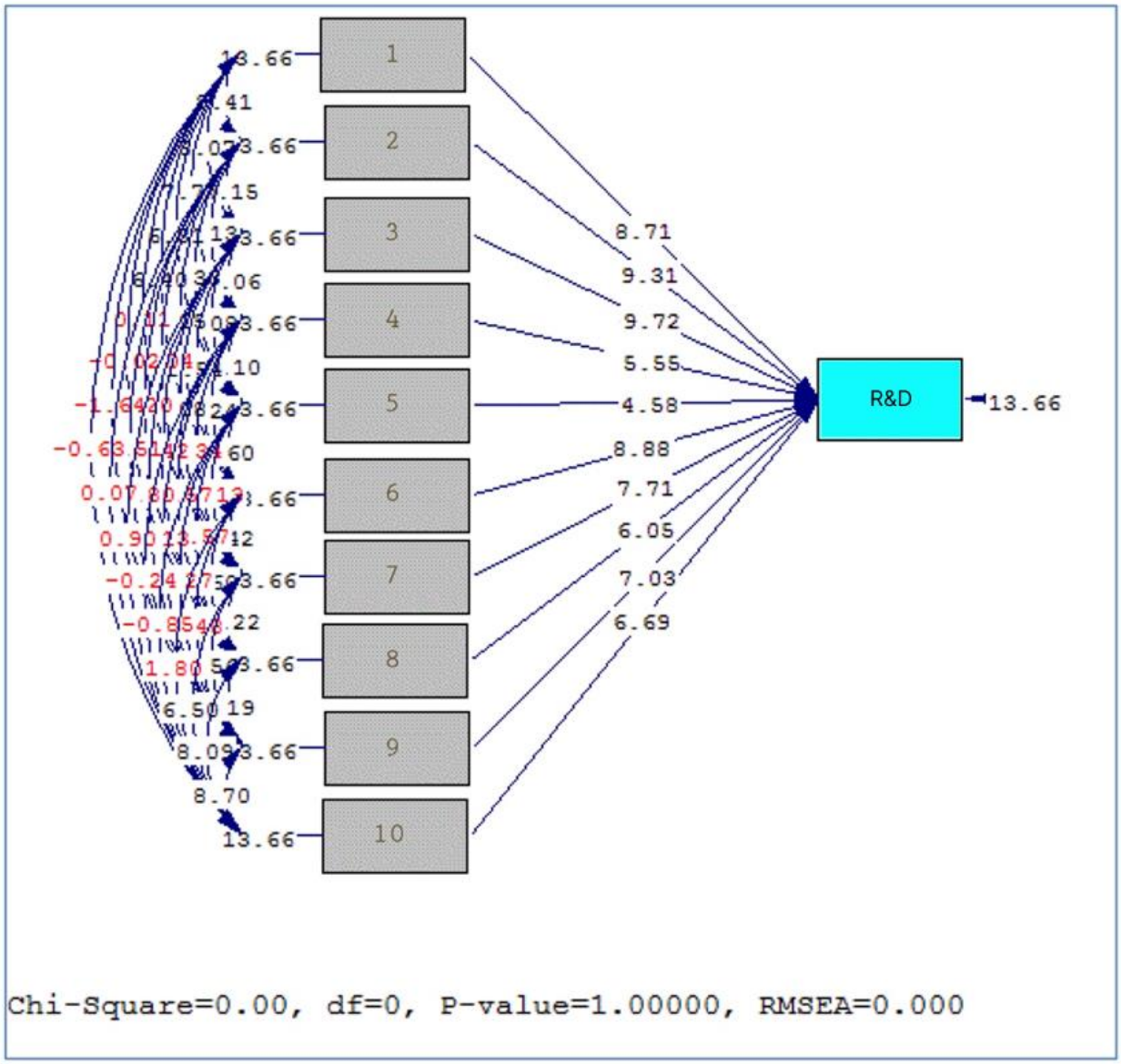

Figure 2. Significance Model Output

Business strategy factors have a significant impact on research and development policies. In the structural equation modeling analysis for testing the research hypotheses, the software output indicates that the structural model has a good fit (χ^2/df = 0.000; RMSEA = 0.000). In other words, the observed data closely align with the conceptual model of the research. The results of the path analysis test show that the significance level or t-statistic is 8.71 (which is outside the range of -1.96 to +1.96). Consequently, it can be concluded that business strategy factors significantly influence research and development policies. Additionally, the path coefficient between these two variables is 0.76. Based on this coefficient, it can be inferred that an increase in business strategy factors leads to an increase in research and development policies, while a decrease in these factors results in a decline in research and development policies.

Supportive policy factors have a significant impact on research and development policies. The results of the path analysis test indicate that the significance level or t-statistic is 9.31 (which is outside the range of -1.96 to +1.96). Therefore, it can be concluded that supportive policy factors significantly influence research and development

policies. The path coefficient between these two variables is 0.85. Based on this coefficient, it can be inferred that an increase in supportive policy factors leads to an increase in research and development policies, while a decrease in these factors results in a decline in research and development policies.

Business investment factors have a significant impact on research and development policies. The results of the path analysis test indicate that the significance level or t-statistic is 9.72 (which is outside the range of -1.96 to +1.96). Therefore, it can be concluded that business investment factors significantly influence research and development policies. The path coefficient between these two variables is 0.80. Based on this coefficient, it can be inferred that an increase in business investment factors leads to an increase in research and development policies, while a decrease in these factors results in a decline in research and development policies.

Business infrastructure factors have a significant impact on research and development policies. The results of the path analysis test indicate that the significance level or t-statistic is 5.55 (which is outside the range of -1.96 to +1.96). Therefore, it can be concluded that business infrastructure factors significantly influence research and development policies. The path coefficient between these two variables is 0.46. Based on this coefficient, it can be inferred that an increase in business infrastructure factors leads to an increase in research and development policies, while a decrease in these factors results in a decline in research and development policies.

Global business perspective factors have a significant impact on research and development policies. The results of the path analysis test indicate that the significance level or t-statistic is 4.58 (which is outside the range of -1.96 to +1.96). Therefore, it can be concluded that global business perspective factors significantly influence research and development policies. The path coefficient between these two variables is 0.33. Based on this coefficient, it can be inferred that an increase in global business perspective factors leads to an increase in research and development policies, while a decrease in these factors results in a decline in research and development policies.

Customer factors have a significant impact on research and development policies. The results of the path analysis test indicate that the significance level or t-statistic is 8.88 (which is outside the range of -1.96 to +1.96). Therefore, it can be concluded that customer factors significantly influence research and development policies. The path coefficient between these two variables is 0.75. Based on this coefficient, it can be inferred that an increase in customer factors leads to an increase in research and development policies, while a decrease in these factors results in a decline in research and development policies.

Business transformation process factors have a significant impact on research and development policies. The results of the path analysis test indicate that the significance level or t-statistic is 7.71 (which is outside the range of -1.96 to +1.96). Therefore, it can be concluded that business transformation process factors significantly influence research and development policies. The path coefficient between these two variables is 0.63. Based on this coefficient, it can be inferred that an increase in business transformation process factors leads to an increase in research and development policies, while a decrease in these factors results in a decline in research and development policies.

Business constraint factors have a significant impact on research and development policies. The results of the path analysis test indicate that the significance level or t-statistic is 6.05 (which is outside the range of -1.96 to +1.96). Therefore, it can be concluded that business constraint factors significantly influence research and development policies. The path coefficient between these two variables is 0.54.

Knowledge capital has a significant impact on research and development policies. The results of the path analysis test indicate that the significance level or t-statistic is 7.03 (which is outside the range of -1.96 to +1.96). Therefore, it can be concluded that knowledge capital significantly influences research and development policies. The path

coefficient between these two variables is 0.67. Based on this coefficient, it can be inferred that an increase in knowledge capital leads to an increase in research and development policies, while a decrease in knowledge capital results in a decline in research and development policies.

Technological factors have a significant impact on research and development policies. The results of the path analysis test indicate that the significance level or t-statistic is 6.69 (which is outside the range of -1.96 to +1.96). Therefore, it can be concluded that technological factors significantly influence research and development policies. The path coefficient between these two variables is 0.50. Based on this coefficient, it can be inferred that an increase in technological factors leads to an increase in research and development policies, while a decrease in these factors results in a decline in research and development policies.

The Analytical Hierarchy Process (AHP) is a multi-criteria decision-making method that can be used to prioritize decision-making options. The core element of this method is breaking down the problem into smaller elements so that these smaller elements can be compared with one another.

To implement the AHP method, the first step involves constructing a hierarchical tree of the problem, which includes the objective, criteria, and sub-criteria. In the next step, a pairwise comparison matrix of criteria and sub-criteria is prepared and presented to the participants in the study. Subsequently, the completed tables are examined for inconsistency rates, and matrices with inconsistency rates greater than 0.1 are returned to participants for reconsideration of their judgments. Finally, the participants' opinions are aggregated using the geometric mean of individual responses to derive the final ranking of options. The evaluation criteria for this study are presented in the table below:

Table 4. Criteria Coding

Criterion	Code
Business Strategy Factors	C1
Supportive Policy Factors	C2
Business Investment Factors	C3
Business Infrastructure Factors	C4
Global Business Perspective Factors	C5
Customer Factors	C6
Business Transformation Factors	C7
Business Constraint Factors	C8
Knowledge Capital	C9
Technological Factors	C10

The consistency ratio (CR) is a mechanism that indicates the consistency of comparisons and determines the reliability of the priorities derived from group members or the combined priority tables. Empirical evidence suggests that if the consistency ratio (CR) is less than 0.10, the comparisons can be considered consistent. In this study, the inconsistency rate of the pairwise comparisons was found to be 0.03, which is below the 0.1 threshold, indicating an acceptable level of consistency.

Table 5. Pairwise Comparison of Criteria Relative to the Objective (Inconsistency Rate: 0.03)

Var.	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10
C1		2.44949	1.41421	0.408248	4.47214	2.44949	0.408248	5.47723	0.117851	0.154303
C2			0.5	0.182574	2	1	0.176777	2.44949	0.111111	0.111111
C3				0.333333	3.4641	2	0.353553	4.47214	0.136083	0.169031
C4					9	5	1	9	0.408248	0.408248
C5						0.5	0.142857	2	0.111111	0.117851
C6							0.235702	2.82843	0.125	0.144338
C7								8.48528	0.408248	0.408248
C8									0.125988	0.136083
C9										2
C10										

After entering the pairwise comparisons into the software, the weight of the criteria can be visualized in the following chart.

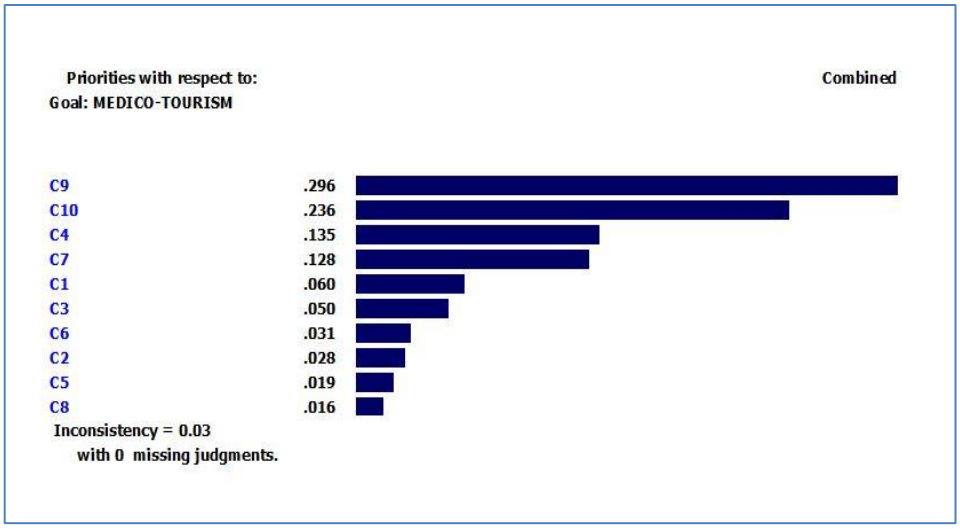

Figure 3. Weight of Main Criteria Based on the Objective

4. Discussion and Conclusion

The results of this study indicate that social media-based marketing variables significantly influence research and development (R&D) policies. Specifically, business strategy factors, supportive policy factors, business investment factors, business infrastructure factors, global business perspective factors, customer factors, business transformation factors, business constraint factors, knowledge capital, and technological factors all demonstrated significant relationships with R&D policies. These findings suggest that businesses leveraging social media for marketing purposes can enhance their R&D strategies by integrating consumer feedback, market trends, and technological advancements obtained through digital platforms.

The impact of business strategy factors on R&D policies was found to be significant, with a path coefficient of 0.76. This finding aligns with the work of Babka (2023), who highlighted the role of social media in shaping business development and strategic innovation [4]. The ability of firms to integrate social media-driven insights into their strategic frameworks can directly influence R&D decision-making, enabling them to allocate resources effectively toward innovation. Similarly, Astawa and Ulwi (2024) emphasized that businesses utilizing social media for market

intelligence can develop strategic initiatives that support research advancements [18]. These findings underscore the importance of incorporating digital engagement metrics into corporate strategy to foster innovation.

Supportive policy factors also had a significant impact on R&D policies, with a path coefficient of 0.85. This is consistent with the findings of Othman and Maarek (2025), who demonstrated that social media can serve as a powerful tool for shaping industry policies by providing businesses with direct access to consumer preferences and regulatory discussions [2]. The increasing reliance on digital platforms for information dissemination allows firms to align their research priorities with evolving industry regulations and market needs. Furthermore, Liyanto and Ainun (2024) found that companies with strong social media engagement experience lower information asymmetry, which can facilitate better decision-making in R&D investments [2].

The results also highlight the significant influence of business investment factors on R&D policies, with a path coefficient of 0.80. This finding is in line with Radjabova (2023), who conducted a network analysis of social media research in entrepreneurship development and found that businesses investing in digital engagement strategies tend to have higher innovation capabilities [9]. Business infrastructure factors were found to have a significant impact on R&D policies, with a path coefficient of 0.46. This is in agreement with the work of Kou (2024), who examined the influence of digital infrastructure on business development and found that companies with robust digital frameworks are better positioned to integrate consumer feedback into their R&D processes [7]. Additionally, Shi (2024) highlighted that the development of social media infrastructure within educational institutions enhances knowledge dissemination, further reinforcing the notion that investment in digital capabilities can lead to improved research outcomes [15].

Global business perspective factors also played a crucial role in shaping R&D policies, with a path coefficient of 0.33. This finding aligns with the research of Nugraha et al. (2024), who investigated the impact of social media on self-identity and found that global digital engagement can influence business strategies. Additionally, Yogapriya and Chettri (2022) examined the role of social media in political decision-making and demonstrated that international engagement through digital platforms can shape policy development [13]. The results of this study suggest that businesses integrating global market trends into their R&D policies can achieve greater innovation potential.

Customer factors were another significant determinant of R&D policies, with a path coefficient of 0.75. This supports the findings of Alvarez-Peregrina et al. (2022), who emphasized that consumer engagement on social media directly affects research priorities in various industries [3]. Similarly, He (2022) explored the influence of social media on teenagers and found that consumer preferences, shaped by digital interactions, can significantly alter business strategies [10]. These findings reinforce the argument that businesses must continuously monitor and analyze customer interactions on social media to inform their R&D initiatives.

The study also found that business transformation factors significantly influenced R&D policies, with a path coefficient of 0.63. This finding aligns with the work of Pathan (2024), who examined social media's role in digital transformation and found that businesses leveraging digital platforms for transformation initiatives tend to experience higher innovation rates [14]. Furthermore, Purificacion and Vallespin (2024) investigated the multifaceted impacts of social media addiction and found that digital transformation plays a critical role in shaping business strategies [17]. These findings highlight the need for businesses to embrace digital transformation as a means of enhancing their research capabilities.

Business constraint factors also had a significant impact on R&D policies, with a path coefficient of 0.54. This finding is supported by the work of Noori et al. (2023), who explored the negative impact of social media on youth

and found that businesses must navigate digital challenges to effectively leverage social media for innovation [5]. Additionally, Erma et al. (2022) examined social media's role in societal conflicts and found that businesses must account for digital risks when developing research strategies [12]. These findings suggest that firms must balance the benefits of social media engagement with potential constraints to optimize their R&D efforts.

Knowledge capital was found to have a significant impact on R&D policies, with a path coefficient of 0.67. This is consistent with the findings of Mushthofa et al. (2024), who examined the mediating role of social media in knowledge dissemination and found that digital engagement enhances intellectual capital [8]. Similarly, Senekal et al. (2022) conducted a systematic review on adolescent development and demonstrated that knowledge-sharing on social media influences research priorities [19]. These findings reinforce the importance of leveraging social media as a tool for knowledge management in R&D.

Finally, technological factors had a significant impact on R&D policies, with a path coefficient of 0.50. This finding aligns with the research of Li (2024), who examined the effects of social media on mental health and found that technological advancements in digital platforms shape business innovation [6]. Additionally, Diniarti and Darraz (2024) investigated the negative effects of social media usage and highlighted the importance of technological adaptation in mitigating digital risks [11]. These findings suggest that businesses must continuously evolve their technological capabilities to enhance their R&D outcomes.

This study has certain limitations that should be acknowledged. First, the research was conducted within the home appliance industry in Iran, limiting the generalizability of the findings to other industries and regions. Future studies should examine the impact of social media-based marketing on R&D policies in different sectors and countries to enhance external validity. Additionally, while this study employed structural equation modeling to analyze relationships between variables, qualitative methods such as in-depth interviews could provide deeper insights into the mechanisms driving these relationships. Finally, the study relied on self-reported data from respondents, which may be subject to response bias. Future research should incorporate objective measures of social media engagement and business performance to strengthen the validity of the findings.

Future research should explore the long-term effects of social media-based marketing on R&D policies, considering how digital engagement evolves over time. Longitudinal studies could provide a more comprehensive understanding of the dynamic relationship between social media marketing and research innovation. Additionally, future studies could examine the role of artificial intelligence and machine learning in enhancing social media-driven R&D strategies, as emerging technologies are increasingly shaping business decision-making. Furthermore, comparative studies between different industries could provide valuable insights into sector-specific challenges and opportunities associated with social media-based marketing and R&D integration.

Businesses should adopt a data-driven approach to social media engagement, leveraging consumer insights from digital platforms to inform R&D decision-making. Implementing real-time analytics tools can help firms monitor market trends and adapt their research strategies accordingly. Additionally, companies should invest in digital infrastructure and employee training to enhance their capacity for integrating social media insights into innovation processes. Organizations should also establish clear policies for social media usage to mitigate potential risks associated with digital engagement, ensuring that online interactions align with corporate values and strategic objectives. By adopting these practices, businesses can maximize the benefits of social media-based marketing while strengthening their research and development initiatives.

Authors' Contributions

Authors equally contributed to this article.

Ethical Considerations

All procedures performed in this study were under the ethical standards.

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Conflict of Interest

The authors report no conflict of interest.

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