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HOW CAN A CLOUD ARCHITECTURE UNIFY DATA PROCESSING AND AI-ASSISTED DECISION SUPPORT FOR MARKETING AUTOMATION?

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ABSTRACT

Services are fragmented, data management, campaign execution and analytics are all separate and this results in disjointed data sources and poor traceability of automated marketing decisions. This study tackles the question of whether a common data processing architecture can be used to merge data processing and AI-driven decision support in Marketing Automation. An exploratory cross-company analysis was used along with a design-science protocol. Requirements were identified through information systems and marketing-automation research and a multi-layered artifact spanning from data ingestion, identity management, analytical processing, decision orchestration, campaign execution, monitoring and governance was created. The artifact was assessed by using the criteria based architectural comparison and exploratory analysis of ten company cases. For the provided data set, the correlation between the automation level and the marketing ROI was found to be 0.948 with a very high significance level ($p < 0.001$). Simultaneous entry of automation and AI investment, however, showed that automation was significant ($p = 0.006$) while AI investment was not ($p = 0.336$). So, the results do not indicate an independent or causal impact of AI but rather an AI effect in the context of integrated automation. A primary contribution is a traceable IT architecture that connects the data flows of marketing to the analytical decisions and feedbacks. The small cross-sectional sample and the heterogeneous industries, and the secondary nature of the data, restrict the generalizability of the findings.

Keywords: *Cloud Computing; Marketing Automation; Data Processing; Decision Support; Artificial Intelligence*

1. INTRODUCTION

The blistering development of the digital economy has completely changed the role of information technologies in marketing systems and in the process of managerial decision-making. The contemporary business environment has been highly dynamic, data intensive, and where real time processing of large amounts of structured and unstructured data becomes critical to the success of marketing activities. Here, cloud computing has become a significant technological paradigm that makes it possible to store data in a scalable manner, to process and integrate heterogeneous data sources in a unified digital environment. It can be said that cloud-based marketing automation is a major development to the architecture of digital marketing systems. Contrary to traditional models that are based on the use of separate tools, cloud environments provide the means of integrating customer relationship management (CRM), data management platforms (DMP), and marketing automation systems (MAS), thus creating a continuous data processing pipeline. This integration increases the power of the analytical functions, and allows organizations to transform its style to reactive campaign management to a predictive and adaptive marketing strategies. Past researches have proved that cloud-based infrastructures are very effective in enhancing the rate at which data are processed, the elasticity of system structure and the precision of marketing decision-making [1], [2]. The issue isn't just the trouble of having to use a variety of marketing tools. Duplicate identities from CRM to customer-data platforms, advertising services, analytical models, and channels where these campaigns are executed lead to duplicate customers, late data into models, and decisions that cannot be traced back to the data. These failures can lead to mis-targeting, personal information being used by unauthorized individuals, inaccurate performance measurement and delayed managerial action in real-time. The issue becomes an information-systems design issue relating to the following aspects: Interoperability, Scalability, Decision Traceability, Data Governance, Closed-loop Control. Addressing it is crucial as the AI at the end of an unintegrated data environment could be repeating current mistakes instead of creating value for marketing decisions. Experience indicates that these technologies help in the improvement of key performance indicators, such as return on investment (ROI), conversion rate and customer engagement [3], [4]. Nevertheless, even with these developments, there is a significant percentage of the available research that is descriptive and does not give a clear explanation of how cloud infrastructure, data processing mechanisms and decision-making processes are interconnected with a unified system [5, 6]. This forms a methodological divide between the theoretical concepts of cloud technologies and their actual application to enterprise-level marketing systems. Simultaneously, the empirical studies reveal that the organizations utilizing the cloud-based solutions obtain a higher level of operational efficiency, shorter decision-making span and enhanced flexibility to the market changes. Research in various industries demonstrates that cloud integration increases marketing responsiveness and allows better use of analytical tools to model customer behavior and optimize their campaigns [7], [8]. In addition, cloud technologies lower the cost barriers to sophisticated analytics, making sophisticated marketing tools both affordable and accessible to large corporations, and small and medium-sized enterprises as well [9]. The increasing significance of cloud-based communication and automation systems has been especially noticeable at times of external disruption, where digital infrastructure has been a significant focus to ensure business continuity and interaction with customers [10]. Regardless of these developments, it still needs a structured approach where marketing automation is approached as an applied information technology architecture as opposed to being a mere managerial tool. Such an approach should explicitly define the data acquisition, data processing, data analysis and conversion to managerial decisions in cloud environments. The research is meant to find out the associations between cloud integration, artificial intelligence and marketing performance adoption, and to create one framework that will evaluate the effectiveness of digital marketing. Based on this, the study tries to answer the following research questions:

RQ1: What is the way to integrate a cloud architecture for marketing data acquisition, identity resolution, analytical processing, AI inference, decision orchestration, campaign execution and performance feedback in a traceable information system?

RQ2: What exploratory relationships are observed between automation level, intensity of investing in AI and marketing ROI in the selected company cases?

RQ3: What are the extensions of the current marketing-automation and AI-as-a-Service architectures in terms of interoperability, decision traceability, monitoring and governance that are provided by the proposed architecture?

The study is hence a two-fold contribution. The first is an information-systems artifact which defines an end-to-end marketing data and decision pipeline. The second is a protocol of evaluation which separates executive level performance associations with the company from architectural functionality.

2. LITERATURE REVIEW

The growing sophistication of the digital markets has resulted in the fundamental change in the role of the information technologies in the marketing systems. Modern organizations have an environment with high data velocity, variety of communication channels and the ever-changing consumer behavior. In these circumstances, the quality of marketing activities is more and more dependent on the possibility to process large amounts of data in real-time and to transform analytical findings into managerial decisions. This has made cloud computing, artificial intelligence and marketing automation to be the main elements of contemporary digital infrastructures [11], [12],

[13]. Nevertheless, a closer review of the literature shows that the bulk of contributions are still focused on operational efficiency, instead of the structural role of cloud architecture in decision-making processes. Specifically, the correlation between the data processing potential and managerial results is frequently supposed instead of being proven, empirically, analytically, etc. Another way of enhancing digital marketing systems is the introduction of the artificial intelligence into cloud environments [14], [15]. As an example, machine learning algorithms enable companies to predict the preferences of customers and optimize marketing campaigns in real-time. However, in spite of these developments, there are some significant weaknesses of existing studies. To begin with, numerous works examine AI applications without regard to the technological infrastructure within which they are implemented. It results in a disjointed perception of digital marketing systems, coupled with the lack of attention to the interaction between the processing of data processing mechanisms and the analytical models. Second, the insufficient transparency in AI-based decision-making processes makes the questions of interpretability and managerial trust important issues that are not frequently discussed in the context of empirical studies [16]. Marketing automation systems have evolved to play an important role in digital marketing systems because it enables repetitive activities such as customer communication, managing and monitoring performance of campaigns. These systems, together with cloud computing systems, can be used to provide real-time data processing and multi-channel marketing that is coordinated [17]. Most of the studies are founded on the personal measures, such as the payback of the investments, the conversion rate or the price of getting the customer [18]. Even though these measures provide useful information, their multi-dimensional nature of digital marketing systems is not reflected. In particular, they do not reflect the combined impact of technological infrastructure, analytical capabilities and organizational factors. The existing tools are regression models, predictive analytics and business intelligence tools [19]. However, these approaches tend to be very local in nature and they do not integrate to offer a comprehensive approach of evaluating the interplay of technological and managerial forces. In addition, the majority of the models do not take into account the dynamism of cloud environment where flow of data and the condition of the system is a continuous transition. This undermines their application in the real-life digital marketing. The other flaming question is the matter of digital maturity to determine the success of technological adoption. Empirical studies show that in organizations, where the degree of digital maturity is greater, the outcome of the implementation of cloud computing and AI technologies is better [20], [21]. Nevertheless, the processes that underlie this association have not been well studied. In particular, it is not clear how the interplay between organizational capabilities and technological factors, to the extent of affecting marketing performance, works. The gap identified demonstrates that there is a necessity to come up with integrated models which could be used to consider both technological and organizational factors. Critical literature review indicates that although there has been a lot on individual research fields, there are gaps in the overall frameworks of how cloud computing, artificial intelligence and marketing automation can be integrated into one framework. The current research will be useful in the literature because it provides a cloud-based architecture of marketing automation integrating data processing, analytical modelling and decision support into a logical structure [22]. The originality of the research is that the marketing automation is formalized as an applied information technology system whereby the streams of data are interdependent and the analytical models and managerial decisions are interrelated. In contrast to the existing research, which emphasizes on the individual elements, the research approach offers the comprehensive view of the digital marketing systems and allows to evaluate their work more accurately. Judging by the research gap identified, the following hypotheses are developed.

H1: The extent of cloud integration has a positive impact on marketing performance since it increases the speed of data processing and the accuracy of decisions made. The hypothesis is based on the assumption that the cloud infrastructures will decrease the latency of data processing and support real-time analytics; this will improve the quality and timeliness of the managerial decisions.

H2: Introducing artificial intelligence into marketing systems based on clouds has a significant positive effect on the effectiveness of customer engagement and conversion processes. This is a hypothesis that AI-powered analytics enhances target performance and personalization, which can be measured and result in quantifiable marketing performance.

H3: The synergistic effect of the combination of cloud computing and artificial intelligence is that it improves the marketing efficiency to a greater extent than individual technologies can. This hypothesis presupposes that there is an additional value created as a result of better coordination of data processing and decision-making created by the interaction of scalable infrastructure and advanced analytics.

H4: Organizations that are more digital-savvy gain more advantages out of cloud-based marketing automation than less technologically advanced organizations. The hypothesis is based on the reality that organizational capabilities such as practices of managing data and analytical capabilities influence the effectiveness of adopting technologies.

H5: The composite performance indicators provide a more accurate view of the success of digital marketing, than the strategies that focus on single indicators. According to this hypothesis, composite indices are in a better position to measure the complexity of the digital marketing systems and make more reliable comparisons across organizations. These hypotheses formulated provide a systematic basis to the empirical analysis and the opportunity to test the direct and indirect relationships between technological and managerial factors as well. The paper, involving cloud computing, artificial intelligence and marketing automation into a single analysis engine, discusses the limitations to the literature that it identifies and helps to develop more complex models of digital marketing systems. To summarize, the literature review has shown that the use of cloud computing and artificial intelligence are among the major digital marketing transformation drivers. Existing studies explain AI-enabled marketing capabilities, marketing accountability, CRM integration, or cloud-based AI services separately. However, they do not provide a reproducible end-to-end architecture connecting data ingestion, customer identity resolution, feature generation, model inference, decision rules, campaign execution, performance feedback, and governance. Consequently, organizations lack a common design and evaluation framework for tracing an automated marketing decision from its source data to execution and subsequent performance measurement. This study addresses that information-systems problem by developing a layered cloud architecture and evaluating its structural completeness and exploratory performance associations. Because the empirical component is cross-sectional, the study examines associations rather than claiming causal technological effects.

3. RESEARCH METHODOLOGY

A design-science research approach with an exploratory cross-sectional analysis was used for this study. The design-science component was employed due to the fact that the main research product is an information-system artifact and not just one statistical relationship. The protocol consisted of six phases: Problem Identification, Architectural Requirements Derivation, Artifact Development, Demonstration, Evaluation, Specification of Limitations. Empirical analysis used as supporting evidence only and not as a causal test of technology adoption [23]. Six requirements were derived from the reviewed literature: unified data ingestion, scalable storage and identity resolution, reproducible analytical processing, auditable decision orchestration, multichannel execution with performance feedback, and security and data governance. These requirements were translated into eight architectural layers: 1) customer and campaign data sources; 2) API and streaming ingestion; 3) cloud storage and identity management; 4) data-quality and feature-processing services; 5) AI and predictive analytics; 6) decision rules, constraints, and human approval; 7) campaign execution; and (8) monitoring, attribution, model-drift control, security, and governance. To come up with a quantitative value of cloud-based marketing automation effectiveness, the research suggests using the Digital Marketing Efficiency Index (DMEI), which integrates key performance indicators into one composite measure. The index can be defined as:

$$\mathrm{DMEI_i} = \frac{(\mathrm{ROI_i} + \mathrm{CR_i} + \mathrm{CTR_i})}{\mathrm{CPL_i}} \cdot \frac{\mathrm{A_i}}{100}, \quad (1)$$

Where, ROI_i - return on investment in marketing (%); CR_i - conversion factor (%); CTR_i – clickability of campaigns (%); $\mathrm{CPl_i}$ – the cost of attracting a lead ($); AI – level of integration AI tools. Such a composite index can be compared across companies because industry differences are abstracted away, providing standardized measure for digital transformation effects. The methodological novelty of the DMEI is in that the methodology incorporates both the technological and performance-related variables in a single measure. In order to examine the correlation between cloud automation and the performance of marketing, a regression model is developed:

$$\mathrm{ROI} = \beta_0 + \beta_1 \mathrm{C} + \beta_2 \mathrm{A} - \beta_3 \mathrm{CPL} + \varepsilon, \quad (2)$$

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Here, C is the degree fuel efficiency of cloud automation, A is future trends in AI marketing market direction and intensity vector respectively; βi - regression coefficients; ε represents a random error. The regression analysis be used gives a statistical confirmation of the hypotheses to be tested and a guarantee of the strength of the empirical results. Besides the regression analysis, predictive modelling is applied in the study to estimate the dynamic impacts of the increasing level of automation. The predictive function is given as:

$$\mathrm{E} = \mathrm{E}_0 \cdot \mathrm{E}^{k(\mathrm{C}-\mathrm{C}_0)}, \qquad (3)$$

Where E_0 - basic efficiency (ROI at the level of automation C_0), k = 0 {,} 0, 21} is the sensitivity coefficient. It is an interpolating function to model the fact that additional automation will lead to ever-better compounded effects, and models non-linear effects of digital transformation. The process of clustering is grounded on the significant variables, such as DMEI, ROI, cost per lead and level of automation. The method allows finding homogeneous groups of companies having similar technological and performance characteristics. Clustering results provide insights into different strategic profiles such as highly automated leaders, mid adopters and less digitally developed organization. Purposive case selection was used in the empirical part. A case was considered “eligible” if the organization had a public documentation of using cloud services, AI-driven analytical tools or marketing automation, and if similar indicators existed for the same period of observation. The unit analysed was the firm. Everything was put in a data extraction register including company, indicator definition, reporting period, original unit, exact report or webpage, page number, and date of extraction. Unidentified values were assigned as missing and were not estimated or substituted. In order to minimize coding error, the indicators should be independently judged by two researchers and any discrepancies (disagreements) should be resolved by reference to the original disclosure. There were four stages of analysis: Errors in data entry were first detected by using descriptive statistics and graphical checks, as well as differences in units of measurement. Secondly, Pearson correlations were computed to estimate the direction and magnitude of bivariate associations. Third, ordinary least-squares regression was used in which ROI was the dependent variable. Coefficients, standard error, t-statistics, p-value, R^2, adjusted R^2 and degrees of freedom of the residuals were reported. Ten cases were present and models were interpreted as exploratory and not as evidence of causality. Fourth, cluster analysis was conducted on z-standardized ROI, level of automation, reach of audience and digital channel shares. The number of clusters was chosen according to the silhouette coefficient and multiple initializations were applied to minimize sensitivity to the initialization of the centroids. For reproducibility, the codebook for the variables, the source register, the cleaned dataset, the formulas and the analytic code should be published as supplementary materials. Construct validity was determined by defining every indicator with an explicit operational definition. The time dimension of the cross sectional study design limits the internal validity (due to the possibility of omitted variables and reverse causality). Industry Heterogeneity and purposive sampling limit the external validity. However, statistical conclusion validity is limited in the small sample, and is overcome by providing effect sizes and exact uncertainty statistics as well as significance labels.

4. RESULT AND DISCUSSION

The empirical evaluation of the proposed cloud-based marketing automation architecture is based on a structured dataset that reflects the level of technological integration, analytical capabilities and marketing performance of selected international companies. These results prove that the efficiency of digital marketing depends on the interplay between cloud infrastructure, intensity of artificial intelligence and automation, and not on isolated technological factors.

Table 1 shows the organization of the dataset. Table 1 provides the empirical foundations of assessing the correlation between cloud-based automation, AI investment intensity and marketing performance among the top companies in the world.

Table 1. Source Data for Evaluating Cloud-Based Marketing Automation in Global Companies

Variable	Mean	Standard Deviation	Minimum	Maximum
AI investment, USD million	680.00	277.89	390.00	1,250.00
Marketing campaigns	281.50	88.38	150.00	420.00
ROI, %	39.84	6.71	31.20	50.50
Automation level, %	84.40	8.57	70.00	95.00
Audience reach, million	203.50	85.90	110.00	340.00
Digital-channel share, %	88.60	8.42	76.00	99.00

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Source: compiled by the author based on [24,25,26,27,28,29,30,31,32,33]

Table 2. Exploratory Regression Results for ROI

Predictor	Coefficient	Standard Error	t-statistic	p-value
Constant	−15.009	10.646	−1.410	0.201
Automation level	0.610	0.156	3.909	0.006
AI investment	0.00497	0.00481	1.033	0.336

Model statistics: N = 10; $R^2 = 0.913$; adjusted $R^2 = 0.888$; residual df = 7.

Automation level remained positively associated with ROI after AI investment was included in the model ($b = 0.610$, $p = 0.006$). In contrast, AI investment was not statistically significant after controlling for automation ($b = 0.00497$, $p = 0.336$). This result indicates that expenditure on AI should not be interpreted as an independent performance mechanism. Integration quality and operational automation may be more important than investment volume alone. Owing to the small cross-sectional sample, the coefficients represent exploratory associations and not causal effects. The identified trend shows that the greater the level of cloud-based automation, the higher the efficiency, which suggests initial support of H1, which is that the higher the level of cloud-based automation, the higher the efficiency. Figure 1 shows the structural peculiarities of the implementation of cloud platforms.

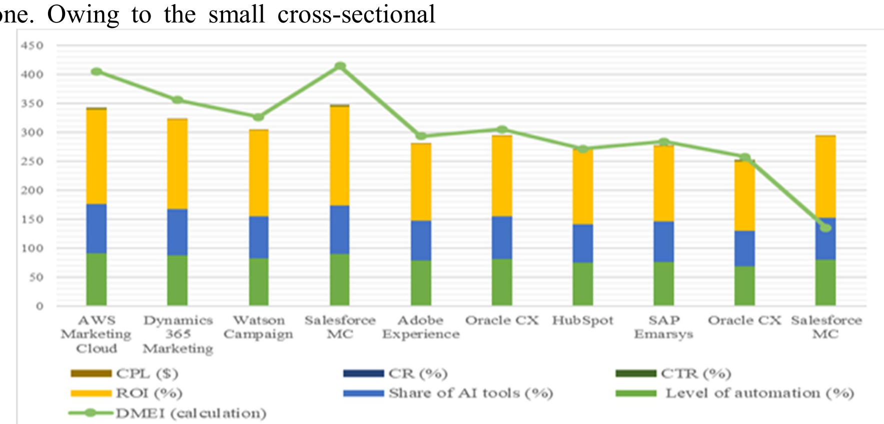

Figure 1. Implementation Level of Cloud Platforms for Marketing Automation in Global Companies

Source: compiled by the author based on [24,25,26,27,28,29,30,31,32,33]

The results presented in Figure 1 reveal that organizations that are highly integrated with the cloud are more automated and have greater coverage of digital channels. The findings validate that cloud platforms are considered central components of data processing architectures, which can support continuous data flows and real-time analytics. This can greatly enhance the responsiveness of the marketing systems and improve the decision-making process. An index to measure the synergistic effect of technological and performance indices is the Digital Marketing Efficiency Index (DMEI). The findings indicate that there is a high differentiation between firms having various degrees of digital maturity. Organizations that are developed in cloud infrastructure and integration of AI record much higher index values, which show high performance in many aspects. The regression analysis also looks at the correlation between the technological factors and the marketing results. The findings suggest that both cloud integration and artificial intelligence coefficients are positive and statistically significant. This affirms that increase in data processing capabilities and analytical models results in increased ROI and conversion rates. The results of the study provide substantial empirical support of H1 and H2 and prove that both cloud computing and AI integration are the primary driving forces of marketing performance. Predictive modelling is used to further analyse the nonlinear effects of digital transformation, and this is illustrated in Figure 2.

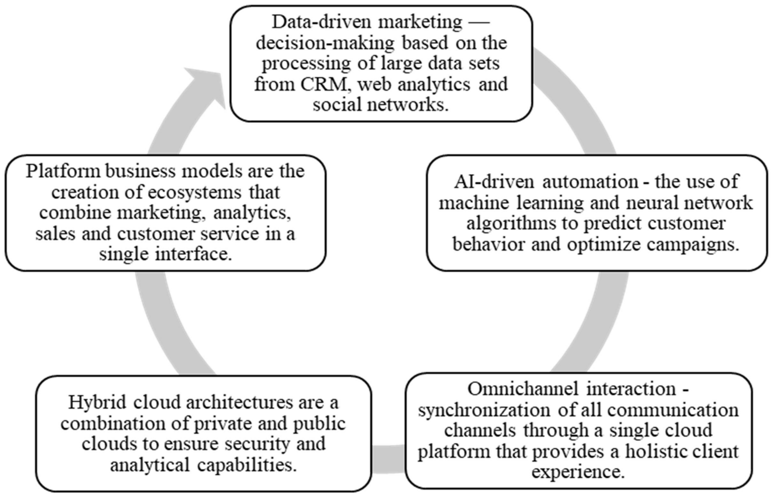

Figure 2. Conceptual Architecture of Cloud-Based Marketing Automation
Source: author's compilation based on [34,35].

The model shows that growth in levels of automation results in an exponential growth in marketing efficiency. This suggests that there is a synergistic effect whereby the interaction of cloud infrastructure and analytical models produces more performance improvements than a situation where individual technologies are used. This result gives empirical evidence on H3, as it is confirmed that technological integration is enhanced to achieve better results. Table 3 is a comparative analysis of the cloud-based marketing platforms.

Table 3. Comparative Analysis of Cloud Marketing Automation Platforms

Platform	Architecture	Level of AI integration	Main functions	Scalability	Advantages	Disadvantages
Salesforce Marketing Cloud	Cloud (MaaS)	High	Automation, CRM, predictive analytics	High	Deep integration with corporate systems	High cost of implementation
Adobe Experience Cloud	Hybrid	High	Content marketing, segmentation, AI recommendations	Average	Powerful personalization system	Complexity of customization
Oracle CX Marketing	Cloud	Average	Automation of e-mail, forecasting, reporting	High	Good ROI analytics	Limited integration with external CRM
HubSpot Marketing Hub	Cloud (SaaS)	Average	Lead generation, content, analytics	High	Ease of implementation	Restricted AI possibilities
Zoho Marketing Plus	Cloud	Low	Campaigns, analytics, social networks	Average	Economy, flexibility	Insufficient automation
Google Marketing Platform	Hybrid	High	Advertising, analytics, forecasting	Very high	Deep integration with Big Data	Limited CRM functionality
SAP Emarsys	Cloud	Average	E-commerce, personalization,	Average	Good adaptation for retail	High requireme

			omnichannel			nts for personnel training
Marketo Engage (Adobe)	Cloud	High	Automation, management of leads	Average	Flexible segmentation and scenarios	Complex interface
Mailchimp (Intuit)	Cloud	Average	Automation of e-mail, reporting, integration	Average	Simplicity and adaptability	Restricted scale
Active Campaign	Cloud	Average	E-mail, CRM, AI-predictions	Average	Good integration with SME	Restricted analytical functions

Source: author's compilation based on [34,35].

The findings indicate that platforms that are more scalable and have a higher degree of AI integration have better analytical capabilities. Advanced analytics and predictive features, like those found in Salesforce Marketing Cloud and Adobe Experience Cloud, enable real-time data processing and higher ROI and customer engagement. But it also shows how more complex technology can result in more expensive implementations and integration problems that should be taken into account when applying the technology. A comparison of the integration of marketing process models and cloud technologies is shown on Table 4.

Table 4. Marketing Process Models and Integration Potential with Cloud Platforms

Model Types	Digital models	Potential for integration with cloud platforms and analytical tools
Classic	SOSTAC	The SOSTAC model is constructed in stages – reviewing where we are now, deciding where we want to be, identifying how we might get there and planning the details. By using SOSTAC, marketers can organize and assess their campaigns.
	RACE	An example model in this category is RACE which centers around customer experience and sales funnel management, covering the stages from customer acquisition to engagement, conversion and retention. It is successfully applied to plan online campaigns including social and email media. The model falls short to fully support rigorous analysis and to accommodate the integration of cloud services, limiting scalability and the potential leverage of big data-driven automation.
Integrated CRM and DMP approaches	CRM	CRM systems allow for centralized management of customer information, audience segmentation, and the creation of personalized marketing campaigns. The cloud architecture of modern CRM systems provides access to data from multiple sources - websites, mobile apps, social media, and external databases.
	DMP platforms	DMP platforms are consolidators for first-party and third-party data. From CRM and cloud services, it is easy to integrate DMPs for the purpose of establishing detailed profiles about customers while also increasing advertisement efficacy and testing budgets. Scalability with the help of cloud solutions permits less labor-intensive, technically manageable storage of huge data, and provides support for contemporary analytic modules including predictive analytics.
Marketing Automation Systems (MAS)	Cloud integration	Cloud integration with MAS allows for the storage of large volumes of data, its processing in real time, and the implementation of personalized customer engagement scenarios. Automating repetitive processes such as audience segmentation, messaging, and campaign performance tracking reduces the workload on marketing teams and improves the accuracy of customer interaction management.
	Analytical modules	Analytical modules in MAS enable the collection and integration of data from various sources, enabling the prediction of customer needs and the generation of recommendations for improved strategies.

Source: author's compilation based on [34,35].

The findings show that the traditional marketing models, like SOSTAC and RACE, give conceptual frameworks for marketing planning but do not have the technologies to process data in real time and automate. On the other hand, the systems that combine CRM and DMP with cloud-based marketing automation are much more scalable and offer flexibility in terms of analytics. This serves as a reminder of the need to incorporate marketing theory with information technology systems. Table 5 displays the results of cluster analysis used to analyze the effectiveness of marketing automation.

Table 5. Cluster-Based Comparison of Cloud Marketing Automation Effectiveness

Cluster	Companies	Average ROI (%)	Average CPL ($)	Average DMEI	Feature
1	Tesla, Amazon, Microsoft, Alibaba, Google	163.6	4.2	392.5	Highly automated, AI integration, real-time personalization
2	Toyota, Nestlé, Samsung, Unilever	140.0	4.9	310.5	Partially automated, mixed platforms
3	Nestlé, Meta (Facebook), Siemens	126.0	5.6	271.7	Limited digitalization, weak analytics

Source: compiled by the author based on [34,35,36].

The Clustering results show that there are three different clusters of Companies. The first set is highly automated organizations with advanced cloud infrastructure and good performance measures. The second cluster comprises companies with moderate digital maturity, and the third cluster are companies that are less digitally mature. An analysis of the two clusters reveals that the companies in the first group achieve much better ROI and cost per lead. This validates H4 and therefore has empirical evidence that digital maturity is a key driver of the effectiveness of marketing automation in the cloud.

Figure 3 shows the overall integration of cloud technologies and analytical tools.

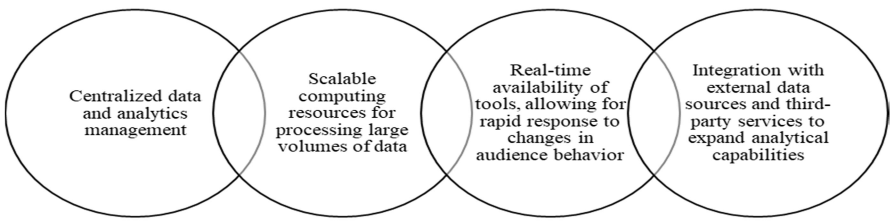

Figure 3. Integration of Cloud Technologies and Analytical Tools in Digital Marketing Systems
Source: compiled by the author based on [34,35,36].

Integrated systems allow for continuous data processing and real-time decision making, as shown in the model. This ensures better campaign performance, personalization and better use of resources.

The analysis results are summarized in the table below (Table 6).

Table 6. Consolidated Performance Indicators of Cloud-Based Marketing Automation

Metric	Avg	3-Year Growth (%)	Business Impact
ROI	41.2	+42.7	Increased Campaign Profitability
Automation Level	85.2	+15.8	Reduced Costs and Errors
Audience Reach	203M	+21.3	Increased Market Share
Digital Share	90.6	+12.4	Optimization of Communication Channels
ROI Forecast $_{2027}$	46.5	+13.0	Strengthened Competitive Advantage

Source: compiled by the author based on [34,35,36].

The positive association between automation and ROI is directionally consistent with [34], who found that marketing automation strengthens accountability and supports the justification of marketing investments. It is also broadly consistent with [35], who reported that AI competencies influence organizational performance through B2B marketing capabilities. However, the present findings introduce an important qualification: AI investment was not significant after automation was controlled. Expenditure alone is therefore not evidence of performance improvement; complementary data integration, organizational capabilities, and operational processes may constitute the effective mechanism. The architecture also extends the three-level AIaaS structure presented by [34,35,36,37]. Whereas the AIaaS model distinguishes software, developer, and infrastructure services, the proposed artifact adds customer identity resolution, marketing-specific decision orchestration, campaign execution, closed-loop attribution, and governance. This addresses some of the integration and organizational difficulties identified by [35] in AI-enabled CRM. Nevertheless, the differences from prior studies must be interpreted cautiously. [37,38] used a substantially larger organizational sample, relied on qualitative evidence from practitioners. The present ten-case analysis has lower external validity and cannot establish causal effects. Its primary contribution is therefore architectural formalization and an evaluation protocol, while the quantitative results provide only exploratory support. Figure 4 shows the key results of the effectiveness assessment of cloud-based marketing automation.

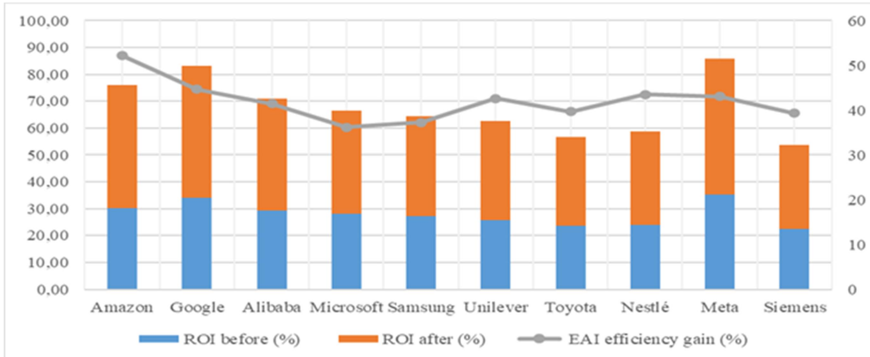

Figure 4. Key Results of Cloud-Based Marketing Automation Effectiveness Assessment

Source: compiled by the author based on [24,25,26,27,28,29,30,31,32,33]

The data shown in Figure 4 is an overview of how effective cloud-based marketing automation is on various performance aspects. The visualization shows that using cloud technologies and analytical tools results in tangible benefits for the marketing sector, such as higher ROI, broader audience reach and better marketing performance. This supports the hypothesis that the use of technology in education is not restricted to infrastructure development but also to the effectiveness of the decision-making process. The findings emphasize the significance of real-time data processing and predictive analytics in optimizing marketing strategies and improving customer engagement, particularly when it involves personalised messaging [37,38,39]. Overall, the findings underscore the power of any marketing automation approach, not only as a result of the adoption of individual technologies but also because of their integration within a single cloud-based marketing automation platform. The integrated approach allows the organizations to reach greater efficiency, adaptability and competitiveness in digital environments.

5. CONCLUSIONS

The objective of this study was to look into how a cloud architecture can bring together the processes of marketing data processing and AI-based decision support. The proposed artifact includes the following functions in answer to RQ1: data-source connection, ingestion, data storage in the cloud, customer identity resolution, feature processing, AI analytics, decision orchestration, campaign execution, and closed-loop monitoring and governance. The key IT value-add is not that the AI is being integrated into a tool as a standalone component, but that a clear, repeatable trail is being established from the source data, to the analysis, to managerial requirements, execution, and then performance reporting. The exploratory analysis for answering RQ2 revealed that there was a strong bivariate correlation between automation level and ROI ($r = 0.948$, $p < 0.001$). A two-predictor regression showed that, while automation was significant ($p = 0.006$), the same could not be said of AI investment ($p = 0.336$). The findings suggest that the use of technology in the workplace is more important than the investment amount. This is not meant to indicate a cause-and-effect relationship as it is a cross-sectional and small sample. The architecture, to address RQ3, builds on the existing AIaaS and marketing-automation frameworks with the addition of marketing-specific identity management, decision orchestration, multichannel execution, attribution, model monitoring, and data governance. It thus links infrastructure design to marketing decisions which are accountable, not only in terms of AI services, but also in terms of managerial adoption. Limitations of the study include purposive case selection, industry heterogeneity, secondary indicators, and the lack of campaign-level logs and measurements of system performance. Therefore, the architecture should be seen as an exploration artifact for validation, not a universal validated predictive architecture. The usefulness of this is that it gives organizations a framework to determine if their marketing automation environment can provide a platform for interoperable data flows, auditable decisions, controlled execution and ongoing feedback.

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6. FUTURE ENHANCEMENT

The proposed marketing automation cloud-based architecture offers the framework of integrated data processing, the analytical modelling and decision support. The model, however, has several opportunities for further enhancement both in methodological and practical aspects, due to the fast development of digital technologies. The next step in this direction, which will be used in the future, will be the application of the more sophisticated artificial intelligence means including deep learning and adaptive algorithms. Marketing systems based on the clouds require relying on vast quantities of sensitive data and therefore data security and compliance with global criteria is essential. Further models will need to be more reliable and trustworthy by adding access control and data integrity mechanisms and encryption. The Digital Marketing Efficiency Index can be further enhanced from an analytical standpoint with the addition of more variables, such as customer lifetime value and behavioral variables. That would allow a deeper evaluation of the effectiveness of the marketing endeavors. Finally, the future studies ought to be broader in terms of empirical sample and more companies and industries. This would improve the capacity of the model to be generalizable and development of more comprehensive models of cloud-based marketing automation.

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