Research Article

Received: 24 June 2023 / Accepted: 23 August 2023 / Published: 5 September 2023

Digitalisation as a Prerequisite for the Groundswell Concept Encouraging the Optimisation of Investments in Online Advertising Using an Audit Approach

Adam Madleňák[1]
Václav Kupec[2]
Vladimíra Hladíková[1*]
Přemysl Písař[3]
Michael Kupec[4]

[1]University of Ss. Cyril and Methodius in Trnava,
Faculty of Mass Media Communication,
Námestie J. Herdu, 2, Trnava,
Slovak Republic
[2]University of Economics and Business,
Faculty of Business Administration,
Nám. Winstona Churchilla 1938/4,
Prague, Czech Republic
[3]University of Finance and Administration,
Faculty of Economic Studies,
Estonská 500, Prague,
Czech Republic
[4]University of West Bohemia,
Faculty of Economics,
Univerzitní 2732, Plzeň,
Czech Republic
**Corresponding Author*

DOI: https://doi.org/10.36941/ajis-2023-0123

Abstract

In an environment of hypercompetition, Industry 4.0 and the impact of the social trend called groundswell on corporate communication mediated through social media, online advertising is critical to enterprise marketing. Moreover, the COVID-19 pandemic has accelerated the transformation from classical advertising to digital. The Controlling/Audit approach could serve as a tool for optimising online advertising performance. The paper analyses a sample of online advertisements (n=248,812) and the finding of this research points to possible significant improvement in CPT (Cost per thousand) ratio and enhanced efficiency of enterprise marketing strategies. Based on the research findings, three linear regression models were developed for improving investment in online advertising. These models were used to set up a controlling/audit approach that was experimentally tested in selected enterprises. Experimental testing proved that Controlling/Audit improved the efficiency of online advertising, in some cases, by over 50% in terms of CPT.

Keywords: *Online Marketing, Groundswell Concept, Controlling, Audit, Artificial Intelligence, Programmatic Advertising*

1. Introduction

The current globalised world and hypercompetitive environment are forcing enterprises to search for new business approaches that reflect the preferences of the groundswell based on feedback from customers and prompting the development of strategies to stay competitive. The COVID-19 pandemic also introduced restrictions that stimulated the transformation to online channels (Belás, Amoah, Dvorský, & Šuleř, 2021). According to Dvorak, Komarkova, & Stehlik (2021), there was a significant increase in demand as well as the quantity of traded goods in the online advertising industry. This research paper focuses on the online advertising industry and its efficiency from a user/consumer perspective, as well as potential optimisations using the approach of modern controlling and audit.

2. Literature Review

The essence of a literature review and content analysis is to look for important connections between the different components of a phenomenon that can lead to new conclusions and reveal the specifics of how the phenomenon works (Bryman & Bell, 2011). For this reason, academic digital resources such as Web of Science, EBSCO, and ProQuest were used for the review. The phrases used for the literature review were Programmatic Advertisement, Artificial Intelligence, Big Data, Data Mining, Web Personalization, Industry 4.0, Controlling, and Auditing. Based on these phrases, articles were selected and then used as sources to identify other relevant articles and resources. As part of the content analysis for this paper, the scope of the literature review was limited to the years 2011 to 2022, as the objective was to capture the link between Programmatic Advertising and selected related topics and techniques.

2.1 Controlling and Audit

The modern controlling approach could be defined as a tool consisting of collecting and evaluating historical data, comparing them with current results, and looking for deviations from actual goals (Laval, 2018). The modern audit as a managerial tool has a similar purpose to controlling. The difference between these tools is defined by Kupec, Písař, Lukáč, & Pajtinková Bartáková (2020), who see audit as a "soft tool" focused on consulting, advising, and verifying data. On the other hand, controlling is perceived as a "hard tool" focused primarily on evaluating data, planning, looking for deviations, and developing new strategies for goal achievement. This thesis was verified and developed from an interdisciplinary perspective by Salehi, Saravani, & Rouhi (2020), who point to the utility of combining controlling and audit tools.

2.2 Industry 4.0, AI, Big Data, Personalisation, and Online Marketing

Industry 4.0 is constantly evolving, and moreover, integrates many sub-topics and tools worthy of academic interest. *"As the 4.0 hype does not stop at E-commerce, solutions by artificial intelligence are driving this agenda like intelligent product and service recommendations or end-consumer communication via AI"* (Bauer, Kryvinska, & Dorn, 2020, p. 1). Industry 4.0 technologies are then being applied to marketing and are fundamentally influencing the performance of the online market (Birkel, Veile, Mueller, Hartmann, & Voigt, 2019) in an international context as well (Liu, Yingying, & Ghauri, 2020), and in some industries they are already quite necessary to maintaining competitiveness (Grubor & Jaksa, 2018). Tools such as Programmatic Advertising, personalized advertising, and other similar techniques are used to target communication to the end customer, and the effect and importance of their use can play a key role for all actors in the online environment (Garrigós, Gomez, & Houben, 2010). The effectiveness of such tools can then be increased with the use of artificial intelligence (Huang & Rust, 2020), consisting of applications on websites that use

artificial intelligence to mimic and adapt to consumer behaviour and communication. Another important element in the entire system is the collection and handling of large amounts of data (Olšovská, Mura & Švec, 2016). Technical papers show that properly executed online tools such as Programmatic Advertising, AI, Big Data, reflecting the reactions of the groundswell and personalization have a direct impact on the economic success of a company (Pappas, Kourouthanassis, Giannakos, & Chrissikopoulos, 2016; Tyrvainen, Karjaluoto, & Saarijarvi, 2020).

2.3 Online Advertising

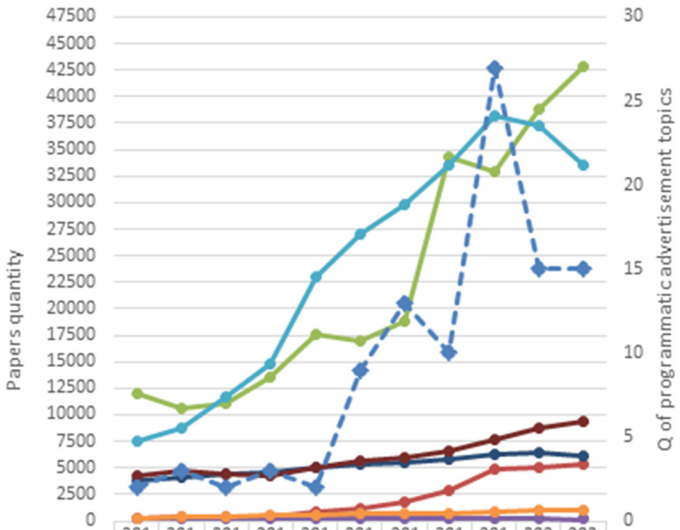
In this era of digital commerce and customer pressure in the form of the groundswell manifestations, information is forever appearing on the markets testifying to the importance of using the tools of modern marketing (Petrů, Kramoliš & Stuchlík, 2020). Advertising plays a key role in the promotion of products and services, and there are differences in the use of advertising depending on the medium in which it is presented. Online advertising has the advantage of ease of implementation, wide reach, cost-effectiveness, and the ability for potential customers to interact with the advertisement (Manik, Gupta, & Kannan, 2016). A quality online advertisement should adhere to three basic parameters: the customer receives quality information from it, it uses quality design, and it is user-friendly (Husin, Destarianto, Dewanto, & Murti, 2019). Its effectiveness increases particularly with the use of personalization, as customers can react negatively to intrusive unsolicited advertisements (Ham, 2016), which personalized online advertising prevents. However, when using online advertising, it is important to be careful that the online advertising is not used in violation of the law (related to the data protection of Internet users), which can happen quite easily to advertisers. Potential customers also react negatively to online advertising that they perceive as spam (Kamaruddin, Mohamed, & Aris, 2020), and there can be a relatively thin line between spam and regular online advertising.

2.4 Programmatic Advertising

The topic of Programmatic Advertising is complicated due to the breadth of techniques that the term encompasses and the approach to terminology and categorization that is not yet unified in the academic world. *"Programmatic advertising - digital automation technology is one type source for automated process (programmed using machines and algorithms) for buying ad space in real time"* (Uday & Arumugam, 2020, p. 3). In general, however, Programmatic Advertising includes all the techniques of measuring, tracking, and analysing internet users with the help of artificial intelligence, personalization, Big Data, etc. with the performance of targeted digital advertising with maximum efficiency and minimum labour cost (Broussard, 2018). The rise in the importance of Programmatic Advertising would not have been possible if the availability of computing technology to the general public had not grown significantly over the last two decades and the computing capacity of IT technologies had not grown along with it. For some time, these have included not only home computers but also handheld IT technologies such as smartphones; whose proliferation, along with the widely developed internet access networks have allowed for automated advertising to be used in new contexts (Ichiki, 2019). Some researchers even argue that these technologies will be quite fundamental in redefining management processes in the future (Jarek & Mazurek, 2019; Davenport, Guha, Grewal, & Bressgott, 2020; Dolobáč, Mura & Švec, 2016). This opens up a wide range of opportunities for managers to engage in programmatic creative work, though they often have to collaborate with developers or other IT staff. It is then not uncommon for a marketer actually to be at least partly a specialist in an IT field as well. Further expansion of the possibilities for the use of Programmatic Advertising can be expected with the gradual increase in the availability of 5G networks, which will enable even faster and easier transmission of large volumes of data (Yuan, Qian, Mo, & Chen, 2020). Nonetheless, big data is already widely available, the cost of handling it is decreasing, and computational algorithms are becoming standard helpers for managers.

2.5 *Content Analysis*

The following content analysis aims to find a link between Programmatic Advertising and Industry 4.0, artificial intelligence, internet personalization, Big Data, controlling, and auditing in the online environment as they appear in the current literature. This content analysis includes not only basic phrases (see the introduction of Chapter 2), but also articles and technical texts containing various combinations of phrases and some derived terms.



	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Industry 4.0	305	327	340	444	927	1123	1815	2814	4891	5052	5346
Artificial Intelligence	12036	10688	11018	13594	17510	16889	18750	34320	32857	38749	42871
Web Personalization	197	201	202	246	307	295	301	205	287	164	158
Big Data	7517	8677	11720	14804	23029	27100	29748	33609	38251	37237	33540
On-line Advertisement	272	317	365	527	549	700	717	764	920	984	952
Audit	3738	4113	4433	4583	5055	5371	5520	5822	6329	6361	6104
Controlling	4255	4802	4472	4278	4970	5591	5963	6625	7714	8687	9307
Programmatic Advertisement	2	3	2	3	2	9	13	10	27	15	15

Figure 1: Analysis of technical texts about online advertising with linked topics
Source: Authors, based on content analysis of academic texts 2011-2021

The graph shows the result of the content analysis, i.e. texts found between 2011-2021 that deal with Programmatic Advertising and texts that deal with related topics, in this case Industry 4.0, artificial intelligence, internet personalization, controlling, auditing, and Big Data within the same timeframe. Since the number of texts on Programmatic Advertising is an order of magnitude smaller, it is plotted on a secondary axis.

From the literature review and content analysis, it was found that Programmatic Advertising and internet personalization are not the focus of researchers in terms of academic investigation, compared to artificial intelligence and Big Data, controlling, auditing, and Industry 4.0. The topic of artificial intelligence is more heavily studied, by an order of magnitude (42,871 texts on AI in 2020

compared to 15 texts on Programmatic Advertising), and the same applies to Big Data. Moreover, the trend of interest in these topics is increasing every year. While Programmatic Advertising has only seen a slight increase in academic interest in absolute numbers over the decade, AI and Big Data as topics have been characterized by a surge in interest (except in 2020 for Big Data). However, the trend in the growth of interest in Programmatic Advertising is upward. Rising academic interest is also evident in controlling and auditing. The topic of Industry 4.0 has seen a sharp increase in interest especially in the last six years, which correlates to the growth trend in interest in Programmatic Advertising. In the first five years of the period under review, fewer numbers of technical texts published on Programmatic Advertising were recorded in the databases surveyed. The absence of a larger number of texts in the years before 2015 can be explained by the relative newness of the topic. One interesting aspect is the persistently low interest in the topic of internet personalisation, which has been at approximately the same level over the last ten years. There is therefore a link between all the topics examined in the literature. The high number of academic texts on AI, Industry 4.0, and Big Data in 2020 and 2021 cannot be explained solely by increased interest due to the coronavirus crisis, since the trend of increasing interest is persistent, as the graph demonstrates.

Thematically related texts on Programmatic Advertising have abounded in the last decade, but scholarly treatment of the topic itself has so far been lacking. This generally has complicated the literature review and content analysis. However, it can be assumed that the trend of growing interest in Programmatic Advertising will also continue to grow, even in absolute numbers, i.e. that the trend in the number of texts will follow a similar course as for the topic of Industry 4.0 over the past ten years. This opens up an unprecedentedly wide range of possibilities for further academic research.

3. Objective, Research Question, Hypotheses

The research objective is to analyse current online advertising with an emphasis on potential optimisation from the advertiser's perspective using the Controlling/Audit approach.

Q1 Are there important differences in performance and efficiency in online advertising between programmatic advertising, direct advertising, and their operators?

H1 The controlling/audit approach can optimise the advertiser's strategy and efficiency in online advertising.

H2 The current online advertising market is optimised; there are no important areas for improvement.

H3 Programmatic advertising has a higher level of performance optimisation compared to direct advertisement.

Q2 Do operators of online advertising trade similar products, or are there big differences? If yes, what are their strategies?

H4 The brand and product marketing strategies of the online advertising operators are more important to advertisers than the actual performance and efficiency of the advertising.

H5 The Controlling/Audit approach can be used as an important tool for optimising the efficiency of online advertising and reducing its costs.

Table 1. Variable's signpost

Var. No	Q	Hypothesis	Tables	Variable details
1	Q 1-2	H 1-5	2, 3	CPT (Cost Per Thousand)
2	Q 2	H 2-3	2	Size – pixels (sorting according to advertisement size and format)
3	Q 1-2	H 1-5	2	Price – used prices by operator's pricelist
4	Q 2	H 1-4	2	Operators – 5 most important operators + others as a 6th operator
5	Q 2	H 2-3	2, 4	Days – duration of the campaign
6	Q 1-2	H 1-5	2	Programmatic advertisement

Var. No	Q	Hypothesis	Tables	Variable details
7	Q 1-2	H 1-3	2	Direct sell advertisement
8	Q 1-2	H 1-5	2, 5	Impression

Source: Authors proceeding

4. Methodology

The research was conducted on the data of the Association for Internet Progress (SPIR) Q1-Q4 2020. SPIR has ranked among the most important players in the Czech Internet economy among publishers, media agencies, and technology companies, with a turnover of more than CZK 40 billion (EUR 1.6 billion) per year (SPIR, 2021). The research was conducted in two stages. The first stage consisted of a data analysis and the second phase was about achieving the results of experimental testing in real practice using the Controlling/Audit approach.

The first phase started with verifying data reliability by computing Cronbach's alpha according to Kramer, Mileva, & Ritchie (2018). The next step in the analysis was to compute the Pearson correlation coefficient, which was used to determine the studied variables and their level of linear dependency. The results achieved were analysed more closely using frequency analysis. The final step of the data analysis was to construct a model according to Darlington & Hayes (2017) using the enter method procedure of linear regression.

The second phase used a randomised sample of online advertisement users. The conclusions and knowledge from the first research phase were used to design and execute the Controlling/Audit approach. This approach was applied and developed for each user (company) and operated for the period from a half year to one year. The research was concluded by verifying the research data results, comparing it to the experimental testing, and summarising the most important findings.

5. Data, Research Sample, Analysis

The research data sample was *n*=248,812 records of cases of implemented online advertising. This sample was tested for data consistency and reliability using the Cronbach's alpha method, where a value higher than 0.7 is interpreted as highly reliable. The Cronbach's alpha calculated for the research sample was 0.889 for *n*=8 variables. This value points to a high degree of data reliability; the results and conclusions of these data analyses may also be taken as reliable.

Following the analysis, the Pearson correlation coefficient was computed according to Wijayatunga (2016). This method evaluates linear dependence in the interval <-1.1>. The absolute values 0-0.3 could be interpreted as low dependency, 0.3-0.7 as moderate dependency, 0.7-0.9 as high dependency, and 0.9-1 as extremely high dependency. The Pearson correlation values follow in table 2.

Table 2. Variables Pearson Correlations

		CPT	Size px	Price	Operator	Days	Progr.ad.	Direct.ad.	Impress.
CPT	P. Correlation	1	.288**	.853**	.154**	.461**	.468**	.331**	.367**
	Sig. (2-tailed)		.000	.000	.000	.000	.000	.000	.000
	N	248812	248812	248812	248812	248812	248812	248812	248812
Size px	P. Correlation	.288**	1	.292**	.701**	.684**	.625**	.409**	.717**
	Sig. (2-tailed)	.000		.000	.000	.000	.000	.000	.000
	N	248812	248812	248812	248812	248812	248812	248812	248812
Price	P. Correlation	.853**	.292**	1	.127**	.480**	.470**	.329**	.362**
	Sig. (2-tailed)	.000	.000		.000	.000	.000	.000	.000
	N	248812	248812	248812	248812	248812	248812	248812	248812

		CPT	Size px	Price	Operator	Days	Progr.ad.	Direct.ad.	Impress.
Operator	P. Correlation	.154**	.701**	.127**	1	.490**	.498**	.302**	.552**
	Sig. (2-tailed)	.000	.000	.000		.000	.000	.000	.000
	N	248812	248812	248812	248812	248812	248812	248812	248812
Days	P. Correlation	.461**	.684**	.480**	.490**	1	.790**	.546**	.720**
	Sig. (2-tailed)	.000	.000	.000	.000		.000	.000	.000
	N	248812	248812	248812	248812	248812	248812	248812	248812
Progr.ad.	P. Correlation	.468**	.625**	.470**	.498**	.790**	1	.718**	.810**
	Sig. (2-tailed)	.000	.000	.000	.000	.000		.000	.000
	N	248812	248812	248812	248812	248812	248812	248812	248812
Direct ad.	P. Correlation	.331**	.409**	.329**	.302**	.546**	.718**	1	.567**
	Sig. (2-tailed)	.000	.000	.000	.000	.000	.000		.000
	N	248812	248812	248812	248812	248812	248812	248812	248812
Impress.	P. Correlation	.367**	.717**	.362**	.552**	.720**	.810**	.567**	1
	Sig. (2-tailed)	.000	.000	.000	.000	.000	.000	.000	
	N	248812	248812	248812	248812	248812	248812	248812	248812

**. Correlation is significant at the 0.01 level (2-tailed).

Source: Authors proceeding by using SPSS ver.25

According to table 2, there are some interesting findings. Programmatic Advertising achieves a higher value of the Person correlation coefficient with all researched variables than with direct advertisement. If we sum all *n*=7 correlations (not including the correlation between Programmatic Ad. and Programmatic Ad. = 1), we reach a result of 4.379. The result of the same procedure for the variable of Direct Ad. is 3.202. The difference between 4.379 - 3.202 = 1.117 is the numerical value of the difference between the performance of programmatic and direct advertisement evaluated by the Pearson correlation analysis method. This finding supports hypotheses H3 and H5. Moreover, the value of the Pearson correlation coefficient between the variables Programmatic Advertising and Direct Advertising reached a value of 0.718. If they were identical, then the Pearson correlation coefficient value would be 1. The difference between both variables (1-0.718 = 0.182) evaluates the "distance" between both online advertising approaches.

Another interesting finding is the value of the Pearson correlation coefficient between the variables of Price and Operator, 0.127, and also between the variables of Operator and CPT (Cost Per Thousand), 0.157. Both values could be interpreted as a low linear dependency (0-0.3). This finding is surprising and points to a sizable gap between real advertising performance and price. It means that advertisers are investing their financial resources, yet receiving highly disproportionate results. This finding refutes hypothesis H2. It is also important to mention that this research works with prices according to price lists, but the actual price is often very different from the official price list – for more details, see chapter 4.3. These findings support hypothesis H5.

The next interesting finding is the correlation between the variable Size px which represents the size of advertisement in pixels, with the variable Size px and Programmatic advertisement at 0.625, Impressions and Days at 0.684, and Size Px and Impression at 0.717. All of the variable correlation coefficients for the variables mentioned reach values around 0.7 – which is the lower limit (0.7-0.9) for a high linear dependency. This could be interpreted as a causality. When we increase one variable, then the other one will increase at approximately the computed value. We can state that with increasing banner size, an advertisement runs more days and makes a stronger impression. It is also important to note the value of 0.701 for the variables Size px and Operators. This number could be interpreted as an operator's specialisation in specific advertisement formats.

Another important finding is the correlation between the variables of Programmatic Advertising and Impression 0.810 (0.7-0.9 = high linear dependency). It could be interpreted that by increasing programmatic advertising channels up to +1, the impression of this advertising will increase up to 0.810. This is important for this research, and also supports hypothesis H5.

For a closer understanding and details of the variables CPT, Days, and Impression, a frequency analysis was used. The results are shown in Tables 3, 4, and 5. These analyses could be used for analysis of the basic KPIs (Key Performance Indicators) of advertising and improvements to its performance.

Table 3. Variable CPT frequency analysis

		Frequency	Percent	Cumulative %
CPT according to price	0-1 €	4323	1.7	1.7
	1-2 €	21619	8.7	10.4
	2-3 €	46928	18.9	29.3
	3-5 €	126549	50.9	80.1
	5-10 €	38896	15.6	95.8
	10-15 €	5557	2.2	98.0
	15 €+	4940	2.0	100.0
	Total	248812	100.0	

Source: Authors proceeding by using SPSS ver.25

According to Table 3, the most important group is CPT, between EUR 3-5. The groups EUR 0-1 and EUR 2-3 represent only 10.4% of all records. The group EUR 2-3 could be used as an achievable advertising goal for advertisers at 18.9% of all records. The remaining groups over EUR 3-5 represent campaigns that have not performed well and should be used in controlling as a limit for determining deviations, for example.

Table 4. Variable Days frequency analysis

		Frequency	Percent	Cumulative %
Campaign duration	1 day	6795	2.7	2.7
	2-5 days	54339	21.8	24.6
	5-10 days	32727	13.2	37.7
	10-15 days	69137	27.8	65.5
	15-20 days	45069	18.1	83.6
	20 days+	40745	16.4	100.0
	Total	248812	100.0	

Source: Authors proceeding by using SPSS ver.25

Table 4 is the most important group for campaigns executed between 10-15 days with 27.8% of total records. It is clear from the analysis of the Days variable that a short-term campaign is less important for advertisers. It could be given, for example, by the need to repeat the campaign to interest the consumer.

Table 5. Impressions

		Frequency	Percent	Cumulative %
Impression	0-1K	17903	7.2	7.2
	1-10K	50632	20.3	27.5
	10-100K	71619	28.8	56.3
	100K-1M	64220	25.8	82.1
	1-10M	36414	14.6	96.8
	10M+	8024	3.2	100.0
	Total	248812	100.0	

Source: Authors proceeding by using SPSS ver.25

Table 5 presents the frequency analysis for impressions. It is clear that advertising campaigns are usually "larger undertakings" with impressions counted from tens of thousands to millions of impressions. Table 5 shows the most common groups: 10,000 – 100,000 impressions at 28.8% and 100,000 – 1,000,000 impressions at 25.8%.

The next research data sample was constructed according to models using the Enter method of linear regression. The complete procedure is presented in model (1) for the dependent variable CPT. The following models were constructed using the same approach and presented only as a final model. The models (three models for three dependent variables) define important factors and their weight for optimising online advertising efficiency. The following models were used in experimental testing as a "key" for optimising advertising using the Controlling/Audit approach – see chapter 3.4. The more detailed computing procedure and specifics of data processing are according to Darlington & Hayes (2017).

Table 6. Model construction by Enter Regression - variable CPT

		B	Std. Error	Beta		
1	(Constant)	.674	.003		205.372	.000
	Price	.816	.001	.814	668.930	.000
	Size px	-.020	.001	-.027	-14.802	.000
	Days	.010	.001	.013	7.082	.000
	Impressions	.011	.002	.013	6.462	.000
	Operator	.016	.001	.021	14.081	.000
	Programmatic ad.	.069	.002	.069	28.458	.000
	Direct ad.	.004	.002	.004	2.513	.012

Source: Authors proceeding by using SPSS ver.25

Model 1. structure – variable CPT
CPT = 0.674 × Constant + 0.816× Price - 0.020 × Size px + 0.010 × Days + 0.011 × Impressions + 0.016 × Operator + 0.069 × Programmatic ad. + 0.004 × Direct ad.

Table 7. CPT Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.857[a]	**.734**	.734	.539	.001	583.473	2	248804	**.000**

a. Predictors: (Constant), Operator, Price, Impressions, Days, Size px, Direct ad., Programmatic ad.

Source: Authors proceeding by using SPSS ver.25

The CPT model (1) explains 73.4% of all analysed cases and is significant at a level of 1%. The constant 0.674 represents the unknown area of the model (suitable for future research). Its value is important compared to the other variables; it is probably caused by a disproportion between the list price and actual traded prices in this market segment. The CPT variable is a derivate of Price. It is not surprising that the constant value is high, though usage is not important for the model. The value of the Price variable is 0.816. This factor is important, but not surprising, when we focus on CPT optimisation. When we compare the values of variables entered to this model, we then recognise the highest variable value, Programmatic advertisement at 0.069, which points to its importance for CPT optimisation. A greater emphasis on Programmatic Advertising leads to an increase in CPT. When compared to Programmatic Advertising, direct advertising has the rather small value of 0.004. Its impact for CPT is de facto zero. Of interest is also the value of -0.020 for the variable Size px. This

means that increasing the size of the format slowly decreases the CPT. Model (1) confirms the validity of the hypotheses H3, H4, and H5, while leading to the refutation of hypothesis H2.

Model 2. structure – variable Days

Days = -0.021 × Constant + 0.699× Programmatic ad - 0.026 × Direct ad + 0.021 × CPT + 0.173 × Price + 0.307 × Size px + 0.073 × Impressions – 0.026 × Operator

The Days model (2) explains 70.0% of all analysed cases and is significant at a level of 1%. The constant -0.021 represents the unknown area of the model. Its value is low and unimportant. The highest value of all variables entered into the model is the variable of Programmatic Advertising at 0.699. This value demonstrates the substantial importance of Programmatic Advertising for a campaign's duration and optimisation and, by way of comparison, the small and negative value of Direct Advertising. Another important variable in model (2) is Size px with a 0.307 value. This value shows a positive relationship between the duration of advertising and increases in the promoted size of banners. Another important factor for model (2) is the variable of Price at 0.173. Model (2) confirms the validity of hypotheses H3 and H5 while also leading to the refutation of hypothesis H2.

Model 3. structure – variable Price

Price = -0.016 × Constant + 0.074× Programmatic ad - 0.013 × Direct ad + 0.787 × CPT + 0.026 × Size px + 0.078 × Days - 0.031 × Impressions – 0.067 × Operator

The Days model (3) explains 74.2% of all analysed cases and is significant at a level of 1%. The constant -0.019 represents the unknown area of the model. Its value is low and unimportant. The interpretation of model (3) is similar to model (2). There is a visible positive impact for the variable Programmatic Advertisement, 0.074, and a negative low value for the variable Direct Advertising, -0.013. Model (3) indicates that, as Price increases, Impressions decrease, but not dramatically. This situation could be explained by the "law of marginal utility". The higher the invested Price, the more similar the advertising portfolio of consumers, and the more Impressions decrease. From model (3) the importance is clear between the variables Price and CPT, with a value of 0.787. This is the highest value, and it is expected. The values of other variables are important for potential price optimisations and managing them based on the Controlling/Audit approach. Model (3) supports the basic model components presented and their values, and ultimately validates hypotheses H3 and H5. According to previous findings, hypothesis H2 is refuted.

6. Research Results of Experimental In-Practise Testing

The conclusions of the data analysis were used to experimentally test practical usability on a random sample of advertisers. The sample of *n*=200 advertisers who were randomly selected using the excel procedure RAND and asked to cooperate in the research. A sample of *n*=31 advertisers was selected for cooperation, where the preliminary research conclusions and findings were applied. The experimental testing was conducted in the following phases.

- In-depth current online advertising analysis via interview, historical advertising data analysis (costs, impressions, impact on advertiser goals and business).
- Based on the analysis, the Controlling/Audit online advertising approach was developed (see figure 1).
- The Controlling/Audit online advertising approach was implemented and customised, when possible, then also connected to the advertiser computer information system (26 of 31 advertisers) for automatic reporting of online advertising KPIs.
- Operate Controlling/Audit online advertising approach, determine process deviation, and apply solutions.
- After 6-12 months of comparing previous and current online advertising results, evaluating and taking corrective or improvement measures when useful.

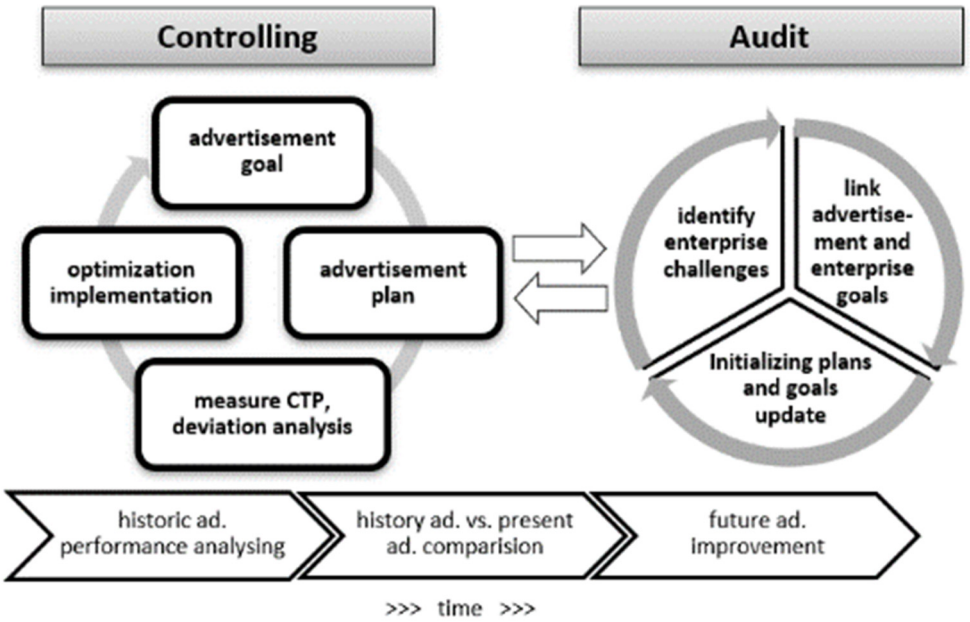


Figure 1. Controlling – Audit online advertisement approach
Source: proceeded by authors, based on analysis results and experimental testing

6.1 Description of the Controlling/Audit Online Advertising Approach

This model is dynamic – operated continuously over time and better performing if powered using the Enterprise Resources Planning (ERP) system with the ability to automatically provide reporting, especially to mobile devices.

6.1.1 Controlling

- Advertising goal – ideally specified using SMART methodology (Reeves, & Fuller, 2018) and using online advertising KPIs (impressions, CPT, total costs, cost per new customer, cost/revenue, …)
- Advertising plan – resource planning (budgeting, HR, other), timeline, milestones, expected results, and defined accepted value of deviation (accepted value of deviations from the planned values).
- Measure deviation analysis – This phase must be conducted continuously in regular terms – ideally once per day (the period may vary, but must be functional in terms of eliminating deviations and taking corrective action). When a deviation from planned values is detected, the analysis part must be emphasised in order to find the origin of the deviation and shape the solution (Rawan, Sweis, & Firas Izzat, 2018).
- Optimisation implementation – the solution for determining deviations is tested and verified for functionality.

By continuously using (dynamically over time) this controlling principle in regular terms, analysing deviations, taking corrective action, and testing the outcome, the advertisers can reach to the phase where they are able to predict future trends and evaluate "what to expect if…" with higher accuracy. This fact is a stimulant for continuous improvement and leads to higher business

performance and competitiveness.

6.1.2 Audit

The role of Audit is to be a "supervisor or consultant". This means that audit is focused on the goals, strategy, current business environment, and challenges of the enterprise.

- Identify enterprise challenges – the current hyper-competitive environment is constantly developing and changing. The enterprise faces challenges, and also threats. Audit monitors this environment and links it to enterprise/advertiser goals.
- Linking advertising and enterprise goals – if there is a discrepancy between an advertising goal and the business environment, the audit initiates a corrective procedure (Brandão, Sousa, & Rodrigues, 2020).
- Initialising plans and updating goals – the second phase is the update of goals and plans in cooperation with the Controlling process.

The Controlling/Audit programmatic advertising optimisation process is constantly running in time, and it is a dynamic process. Historical data are important mostly for comparison to the present situation, and emphasis is placed on the future – prediction and setting and achieving goals.

6.2 Experimental Testing – Findings and Results

The experimental testing was conducted on a sample of 31 advertisers. Throughout this experimental testing, the results of the analysis were verified along with previous interesting findings.

Price of online advertising – there is a big gap between the list price and actual expense for advertisement. The common practice is to "use marketing" while trading online advertising. The operators (not all of them) are usually offering advertising campaigns for price X, but then offer big discounts, and the traded Price is usually between 0.7 – 0.3 of X. With this approach, operators optimise the overall portfolio of advertising and sell it with less powerful advertising as a "package". The role of the operator brand is also important. According to the KPI analyses, the operator brand can change the Price of an advertising package x times higher. Based on the experiences of advertiser personnel –online advertising is influenced by operator marketing, uses a personal approach to advertisers and the tactic of offering big discounts to promote the feeling that the cooperation with their client is important and unique. By comparing certain KPIs it is clear that the same product could be traded X times higher. This creates a paradox – Programmatic Advertising is highly optimised compared with other approaches, but is traded by operators and their "marketing and brand" approach. The final product can then be inefficient for advertisers, and Controlling/Audit programmatic advertising optimisation could be a way to change it. This finding explains some disproportionate conclusions in correlation analysis and models 2, 3, 4 in questions that arise about the variable Price and partly its derivate variable CPT.

Throughout the experimental testing, only three advertisers stated that they had not seen an improvement in advertising performance using Controlling/Audit programmatic advertising optimisation. Not a single advertiser stated that advertising performance was decreasing. In total, 28 advertisers achieved CPT optimisation. The average CPT optimisation –Price decrease was 19.8%. For more details, see table 8.

Table 8. Advertiser performance experimental testing – CPT

Improvement		Advertisers	Percent	Cumulative %
Campaign CPT	negative	0	9.7	9.7
	stagnation	3	6.5	16.1
	0 to 5 %	2	12.9	29.0
	5 % to 10 %	4	35.5	64.5

Improvement		Advertisers	Percent	Cumulative %
	10 % to 25 %	6	19.4	83.9
	25 % to 50 %	3	9.7	93.5
	more than 50 %	2	6.5	100.0
	Total	31	100.0	

Source: proceeded by authors with SPSS ver. 25, based on analyse results and experimental testing

The core of Controlling/Audit programmatic advertising optimisation was using online advertisement with an emphasis on programmatic channels from multiple operators and its evaluation based solely on identified KPIs. Using this approach, the advertising was "stronger" and the advertiser was able to use facts to support arguments in the negotiation process with the operator. It is also important to mention that in 3 enterprises, the Controlling/Audit programmatic advertising optimisation was helpful with breaking the cooperation between the operator and the advertiser's employee who takes "gifts" from an operator at the expense of defending the advertiser's business interests. Controlling/Audit programmatic advertising optimisation used models 1, 2, 3 and with these models determined factors and their values as the key to advertising optimisation planning. Based on the findings of the analyses and its experimental in-practise testing, hypothesis H1 has been confirmed.

Using Pearson correlation analysis, constructed models 1, 2, 3, and experimental testing, it was determined that for advertisers the brand and product marketing strategies of the online advertising operator is more important than real advertisement performance. According to these experimental testing findings, hypothesis H4 has been confirmed.

By operating this research, the following research questions can be answered.

Q1 - according to the Pearson correlation analysis and models 1, 2, and 3, it was proven that Programmatic Advertising is better optimised and its performance is higher.

Q2 - based on experimental testing it was found that the brand of operators and their trade tactics is creating a big gap between operator pricelists, real prices, and advertising offered in "packages" and real advertising performance. The Controlling/Audit programmatic advertising optimisation approach was tested on experimental advertiser samples and its interesting findings verified.

7. Discussion

The importance of the use of online advertising for markets, but also for the functioning of society, has been significantly reinforced by the global pandemic crisis caused by the COVID-19 disease. This crisis resulted in the collapse of economies around the world in 2020, and with it changed consumer behavior. In addition to a decline in overall willingness to buy, consumers have shifted their shopping activities to the online environment (Almehmadi, 2021). And if the customers are already in the online environment and willing to buy, there is especially wide scope here for the application of programmatic advertising (Uday & Arumugam, 2020). Since competitors must necessarily come to a similar conclusion, the proper setup of the techniques of measuring, tracking, and analysing internet users and their use in marketing is one of the key aspects of a company's success. A business that wants to remain competitive must respond flexibly and try to retain customers through adequate means of communication (Tyrvainen, Karjaluoto, & Saarijarvi, 2020; Belás, Amoah, Dvorský, & Šuleř, 2021). However, it is necessary not only to engage in communication alone, but first and foremost to determine the communication depth to which the company has managed to engage the customer.

The necessary condition for increasing the efficiency of online advertising is continuous performance monitoring, evaluating, and based on that, optimising. The Controlling/Audit approach as a time dynamic methods approach was assessed as an effective tool. The best result by this approach was achieved when the user implemented the Controlling/Audit approach into their information system and was able to evaluate and manage performance ideally in real time

(Groenewald & Okanga, 2019). It is important to note that the research has limited data (short timeline), and the conclusions come from the times of big and rapid changes caused by the COVID pandemic, which can be described as highly turbulent. We can expect that after some time, market principles will push the industry to optimise, and it is possible that over time, the large gap between the actual performance of online advertising and its price will narrow or become insignificant.

8. Conclusion

The importance of the online advertising industry is rapidly increasing. The COVID-19 pandemic, digitisation and also consumers (united in the form of the groundswell) have significantly influenced online advertising in recent years, and we can expect its rapid development. This research study has encountered exciting findings. From a fundamental perspective, the researchers expected a high level of online – especially programmatic – advertising optimisation. This expectation was met. What was unexpected was the understanding that online/programmatic advertising is the "only product" that is traded by its operators and is subject to the influence of marketing approaches and strategies. Our research found that the process and efficiency of programmatic advertisement are well optimised. The other aspect of this problem is that online advertising is only a "product", and the same principles therefore apply as in other markets. The results of research data verified by experimental testing point to an enormous gap between online advertising and its real performance as evaluated by CPT. The Controlling/Audit approach to online advertising developed and specified based on the research findings is presented as an effective tool for optimising online advertising, as well as a catalyst for innovation and effectiveness.

9. Acknowledgements

The research was supported by the Scientific Grant Agency of the Ministry of Education, Science, Research and Sport of the Slovak Republic and the Slovak Academy of Sciences (VEGA, No. 1/0458/21) under the project entitled "Management of the "groundswell" concept by business entities in promotion of environmentally-friendly products in times of technology interference".

References

Almehmadi, A. (2021). COVID-19 Pandemic Data Predict the Stock Market. *Computer Systems Science & Engineering*, 36(3), 451-460. https://doi.org/10.32604/csse.2021.015309

Bauer, W., Kryvinska, N., & Dorn, J. (2020). *Model of Trust Management for Digital Industry Services. Towards E-Commerce 4.0.* Ithaca: Cornell University Library.

Belás, J., Amoah, J., Dvorský, J., & Šuleř, P. (2021). The Importance of Social Media for Management of Smes. *Economics & Sociology*, 14(4), 118-132. http://dx.doi.org/10.14254/2071-789X.2021/14-4/7

Birkel, H. S., Veile, J. W., Mueller, J. M., Hartmann, E., & Voigt, K.-I. (2019). Development of a Risk Framework for Industry 4.0 in the Context of Sustainability for Established Manufacturers. *Sustainability*, 11(2), 1-27.

Brandão, A., Sousa, J. C. C., & Rodrigues, C. (2020). A Dynamic Approach to Brand Portfolio Audit and Brand Architecture Strategy. *European Business Review*, 32(2), 181-210. http://dx.doi.org/10.1108/EBR-12-2018-0206

Broussard, G. (2018). *Programmatic In-Housing: Benefits, Challenges, and Key Steps to Building Internal Capabilities.* [Online] Available: https://www.iab.com/wp-content/uploads/2018/05/IAB_Programmatic-In-Housing-Whitepaper_v5.pdf

Bryman, A., & Bell, E. (2011). *Business Research Methods*. Oxford: Oxford University Press.

Darlington, R., & Hayes, A. (2017). *Regression Analysis and Linear Models: Concepts, Applications, and Implementation*. The Guilford Press: New York, NY, USA.

Dolobáč, M., Mura, L. & Švec, M. (2016). Personnel Management and the New System of Dual Education in Slovak Republic. *Actual Problems of Economics*, 181(7), 282-289.

Dvorak, J., Komarkova, L., & Stehlik, L. (2021). The Effect of the COVID-19 Crisis on the Perception of Digitisation in the Purchasing Process: Customers and Retailers Perspective. *Journal of Entrepreneurship in Emerging Economies*, 13(4), 628-647. http://dx.doi.org/10.1108/JEEE-07-2020-0260

Garrigós, I., Gomez, J., & Houben, G.-J. (2010). Specification of Personalisation in Web Application Design. *Information and Software Technology*, 52(9), 991-1010.

Groenewald, D., & Okanga, B. (2019). Optimising Enterprise Resource Planning System to Leverage a Firm's Absorptive and Adaptive Capabilities. *South African Journal of Information Management*, 21(1), 1-15.

Grubor, A., & Jaksa, O. (2018). Internet Marketing as a Business Necessity. *Interdisciplinary Description of Complex Systems*, 16(2), 265-274.

Ham, C.-D. (2016). Exploring How Consumers Cope with Online Behavioral Advertising. *International Journal of Advertising*, 36(4), 632-658.

Huang, M.-H., & Rust, R. T. (2020). Engaged to a Robot? The Role of AI in Service. *Journal of Service Research*, 24(1), 30-41.

Husin, H., Destarianto, P., Dewanto, W., & Murti, G. (2019). Analysis of Online Advertising Content on Purchase Decision in Marketplace. *International Conference on Computer Science, Information Technology, and Electrical Engineering*. Jember: International Conference on Computer Science, Information Technology, and Electrical Engineering (ICOMITEE), 59-64.

Ichiki, N. (2019). Real-Time and Automatic Internet Advertisement Delivery Service through AI Analysis and Data Integration. *Fujitsu Scientific and Technical Journal*, 55(4), 44-49.

Jarek, K., & Mazurek, G. (2019). Marketing and Artificial Intelligence. *Central European Business Review,* 8(2), 46-55.

Kamaruddin, N. N., Mohamed, A., & Aris, S. R. (2020). Online Advertising on Consumer Purchasing Behavior: Effective Elements and its Impact. *3rd International Conference on Networking, Information System & Security (NISS'20)*. Marrakech: Assoc Computing Machinery, 1-7.

Kramer, R., Mileva, M., & Ritchie, K. I.-R. (2018). Inter-Rater Agreement in Trait Judgements from Faces. *PLoS ONE*, 13, e0202655. https://doi.org/10.1371/journal.pone.0202655

Kupec, V., Písař, P., Lukáč, M. & Pajtinková Bartáková, G. (2021). Conceptual Comparison of Internal Audit and Internal Control in the Marketing Environment. *Sustainability*, 13, 6691. https://doi.org/10.3390/su13126691

Laval, V. (2018). *How to Increase the Value-Added of Controlling.* Gruyter: Berlin.

Liu, C.-L., Yingying, Y. Z.-Z., & Ghauri, P. N. (2020). The Influence of Internet Marketing Capabilities on International Market Performance. *International Marketing Review*, 37(3), 447-469.

Manik, P., Gupta, A. P., & Kannan, G. (2016). A Goal Programming Model for Selection and Scheduling of Advertisements on Online News Media. *Asia-Pacific Journal of Operational Research*, 33(2), 1-41.

Olšovská, A., Mura, L. & Švec, M. (2016). Personnel Management in Slovakia: An Explanation of the Latent Issue. *Polish Journal of Management Studies*, 13(2), 110-120.

Pappas, I., Kourouthanassis, P., Giannakos, M. N., & Chrissikopoulos, V. (2016). Shiny Happy People Buying: The Role of Emotions on Personalised E-Shopping. *Electronic Markets*, 193-206.

Petrů, N., Kramoliš, J., & Stuchlík, P. (2020). Marketing Tools in the Era of Digitization and their Use in Practice by Family and Other Businesses. *E&M Economics and Management*, 23(1), 197-212. https://doi.org/10.15240/tul/001/2020-1-014

Rawan, A. S., Sweis, R. J., & Firas Izzat, M. S. (2018). Investigating the Impact of Hard Total Quality Management Practices on Operational Performance in Manufacturing Organisations. *Benchmarking*, 25(7), 2040-2064. http://dx.doi.org/10.1108/BIJ-05-2016-0074

Reeves, M., & Fuller, J. (2018). When SMART Goals Are Not so Smart. *MIT Sloan Management Review*, 59(4), 1-5. [Online] Available: https://www.proquest.com/scholarly-journals/when-smart-goals-are-not-so/docview/2074384329/se-2?accountid=37662

Salehi, M., Saravani, M., & Rouhi, S. (2020). The Relationship between Audit Components and Audit Market Adaptability. *Journal of Financial Crime*, 27(3), 835-853. http://dx.doi.org/10.1108/JFC-03-2020-0035

SPIR. (2021). *SPIR.* [Online] Available: https://www.spir.cz/en

Tyrvainen, O., Karjaluoto, H., & Saarijarvi, H. (2020). Personalisation and Hedonic Motivation in Creating Customer Experiences and Loyalty in Omnichannel Retail. *Journal of Retailing and Consumer Services,* 57, 1-10.

Uday, K., & Arumugam, T. (2020). Role of Programmatic Advertising on Effective Digital Promotion Strategy: A Conceptual Framework. *Journal of Physics: Conference Series*, 1716(1), 012032.

Wijayatunga, P. (2016). A Geometric View on Pearson's Correlation Coefficient and a Generalisation of It to Non-Linear Dependencies. *Ratio Math*, 30, 3-21.

Yuan, Q., Qian, Q., Mo, Y., & Chen, H. (2020). Research on Mixed Planning Method of 5G and LTE. *3rd International Conference on Information and Computer Technologies (ICICT)*, 489-493.