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Assessment of Digital Marketing Technologies using TOPSIS Method

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Abstract - The marketing industry is constantly evolving as digital technology and their applications spread. Consumer behavior, company structures, marketing approaches, and competitive capacities are all impacted by this shift. For large and medium-sized businesses, digital technology has made them more competitive than competitors in the market when it comes to sales. Public relations can be given a significant boost thanks to the widespread adoption of digital technology in marketing. There are many competing goals and numerous parameters to consider when evaluating digital marketing technologies. When it comes to solving these kinds of issues, multi-criteria decision making (MCDM) is a strong instrument. The purpose of our work is to develop an evaluation framework for digital marketing technology using MCDM techniques. MCDM approaches are utilized in the evaluation process after developing the evaluation criteria and alternatives. The weights of the criteria are determined by the Analytic Hierarchy Process (AHP), and digital marketing technologies are ranked using Technique for Order of Preference by Similarity to Ideal Solution (TOPSIS). Finally, an application of the proposed methodology is demonstrated.

Key Words: AHP, TOPSIS, Digital technology, Marketing, MCDM.

I. INTRODUCTION

The marketing industry is constantly evolving as digital technology and their applications spread. Consumer behaviour, company structures, marketing approaches, and competitive capacities are all impacted by this shift. Digitalization is a key marketing concept for staying on top of the ever-changing landscape. Building a digital brand image and enhancing the brand's worth have become increasingly important. Utilizing digital platforms, companies can easily reach their customers, manage sales and orders, and maintain good client relations long after the sale has been completed (Hanson & Kalyanam, 2000; Mort & Drennan, 2002; Siau & Yang, 2017).

For large and medium-sized businesses, digital technology has made them more competitive than competitors in the market when it comes to sales. If you're using digital technology in marketing, you can build a long-term, mutually beneficial relationship with your clients by enhancing the power of public relations the most. There are many competing goals and numerous parameters to consider when evaluating digital marketing technologies. When it comes to solving these kinds of issues, multi-criteria decision making (MCDM) is a strong instrument. It is one of the most often addressed issues in academic writing. Finding the best solution from all possible options is the goal of MCDM. Analysis Hierarchy Process (AHP), which derives its total values for each alternative from relative weights of the various elements, is an exceptional MCDM approach (Saaty, 2005). It is used to rank and assess options in terms of importance and benefit evaluations using COPRAS. Because of its simplicity, it is less time-consuming than other MCDM approaches such as TOPSIS. Qualitative as well as quantitative factors can be evaluated using this approach. According to the findings, MCDM methodologies can be used to develop an evaluation framework for digital marketing technology. MCDM approaches are utilized in the evaluation process after developing the evaluation criteria and alternatives. For establishing the weights of criteria, AHP is utilized, and TOPSIS is used to rank digital marketing technology.

II. LITERATURE REVIEW OF DIGITAL MARKETING TECHNOLOGY

There is numerous research on digital marketing in the literature, which has been a hot topic in recent years. In general, these studies focus on the marketing concept as a whole. A lack of academic research has been done on the usage of digital marketing with cutting-edge technology. On Tab. 1, you'll see these findings.

Table 1. Literature review of digital marketing technology

Author (Year)	Aim of the Study	Application Area
Langan et al. (2019)	To construct the state of art digital marketing in academia	Digital marketing courses
Hardy et al. (2018)	To evaluate the impact of marketing and education on knowledge	Carrier screening
Teixeira et al. (2018)	To find the most relevant and important factors in the adoption of digital marketing in startups	Start ups
Ghotbifar et al. (2017)	Identify and assess factors affecting skill gap in digital marketing	Communication industry
Kosasi & Yuliani (2017)	To identify and analyze to what extent digital marketing strategy can improve organizational agility of MSMEs	Micro, small, and medium enterprises (MSMEs)
Tardan et al. (2017)	To formulate a digital marketing strategy for mobile commerce	Mobile commerce based collaborative consumption organizations

In some research, MCDM technologies are used in the "digital marketing" industry. For example, Watrobski et al. (2016) used an MCDM technique known as TOPSIS to analyse marketing management. The Fuzzy ANP tool was utilised by Kaltenrieder et al. (2016) to optimise digital marketing campaigns. For this study, Khatwani and Das (2016) employed an MCDM system to examine the influence of demographic characteristics on information channels.

There is no research in the literature that combines digital marketing with technology using MCDM methodologies. This study aims to bridge this knowledge gap by combining MCDM analytic approaches with a digital marketing technology review.

Major players have more than doubled their manufacturing capacity in India's sanitary ware business in the last six to seven years. The enterprises have also introduced battery casting, beam casting, and the latest imported quick burning cycle kiln technology to their manufacturing process. Furthermore, these businesses have improved their product quality and offered higher-priced items to the market, which have been well received. In India, demand for high-quality sanitary gear is on the rise. High-value manufacturing demands are being satisfied by enterprises, and as a result, the realisation per metric tonne is quite good, resulting in good profitability.

With the goal of persuading Indian consumers to buy only high-quality goods, corporations have launched an intensive advertising campaign. There has been an increase in the number of corporations offering showroom incentives and opening their own retail locations in key cities, as well. In India, the demand for sanitary products is increasing at a rate of 15% to 17% each year.

III. THE PROPOSED MODEL AND METHODOLOGY

The proposed methodology in this study consists of three basic steps:
Step 1. Determination of criteria and alternatives for evaluation of digital marketing technologies.
Step 2. Determination of the evaluation criteria's importance degree in the proposed model by AHP method.
Step 3. Evaluation of digital marketing technologies by TOPSIS method according to the criteria.

As a result of the literature review and expert opinions, the digital marketing technology evaluation model is shown as in Fig. 1.
In this model, there are three main criteria: customer, company and market. There are three sub-criteria of this each main criterion.

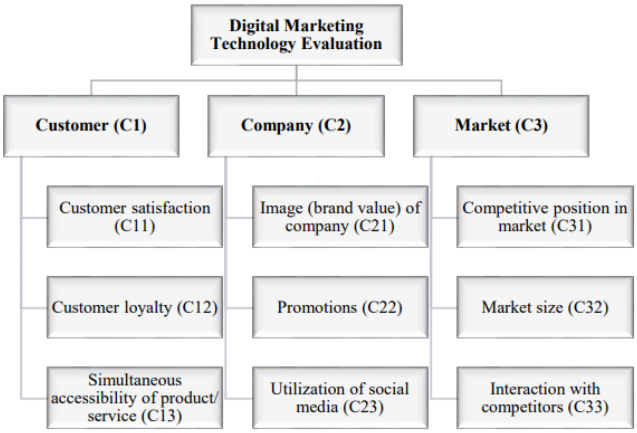

Figure 1: The proposed evaluation model

There's no denying the importance of digital technology in today's digital marketing.
Digital marketing makes use of the following tools:
Chatbots, automated assistants, and smartphone apps like Siri and Alexa are all examples of artificial intelligence goods, which are commonly found on websites. This chatbot keeps track of your preferences and offers suggestions that are tailored to them. **Artificial intelligence**-supported conversational interfaces are critical for businesses. It is their belief that digitalization is the only way to ensure high-quality connection with customers (Büchner & Mulvenna, 1998; Wierenga, 2010; Martnez-López & Ca sillas, 2013, Membrillo, 2019).
In order to better comprehend human behaviour, make forecasts, and so on, the notion of "**Big Data**" was coined. The organisations are able to give smart management as a result of the data they have access to thanks to big data. Aside from location in social media networks and lifestyle skills, marketers can use these tools to engage with customers based on their preferences (Burns et al., 2000, Tirunillai & Tellis, 2014; Verhoef, Kooge & Walk,2016).
Augmented/Virtual Reality: Augmented reality refers to the use of computer-generated sensory inputs to augment the real-world physical environment. With augmented and virtual reality, companies are influencing customers by offering them with new and unique experiences that aren't ordinarily possible. Consumers may see how their products are made throughout the manufacturing process through the use of virtual reality applications. With a thrilling experience, customers learn about the things they buy and become more interested in the brand (Burns et al., 2000; Zhang et al., 2000; Barnes, 2016).
Nowadays, marketers need more information than gender, ethnicity, age, and work status to completely understand their clients for building user segments such as user profiles, social postings, and interests and determining the right communication strategy for each campaign. With **machine learning,** marketers can access all of this client information and use it to build meaningful relationships (Cui et al., 2006; Siau & Yang, 2017).
Faster marketing processes and real-time marketing are made possible by the **Internet of Things (IoT).** The time between marketing and sales has been cut and the sales process has gotten more easier as a result of the Internet of Things. Internet-enabled objects allow customers to simultaneously and broadly satisfy their wants by learning from their daily

lives (Burns et al., 2000; Jara et al., 2014; Nguyen & Simkin, 2017).

3.1 Analytical Hierarchal Process (AHP)

The weights of the criteria are estimated by AHP, which involves 3 steps.

Step 1: Developing a hierarchal structure with a goal at the top level, the criteria at the second level and the alternatives at third level. Here the goal is nothing but finding weights for each criterion.

Step 2: To determine the relative importance of different criteria with respect to goal a pair wise comparison matrix is developed based on the scale of relative importance. Scale of relative importance: 1 - equal, 3 - moderate, 5 - strong, 7 - very strong, 9 - extreme strong, 2,4,6,8 - intermediate values. All the elements in the column of pair wise comparison matrix are obtained by dividing the first element in a row with the remaining every elements in that row respectively. After creating pair wise comparison matrix, normalized pair wise comparison matrix is created by adding all elements in a column of pair wise comparison matrix, to get a value for every criteria in every column. Then every element in a column of pair wise comparison matrix is divided with respective sum value of that column. The prepared normalized pair wise comparison matrix.

Step 3: Calculating the consistency to check whether the obtained criteria weights are correct or not, for this pair wise comparison matrix is taken and the column elements are multiplied with the criteria weight. Then the weighted sum value is calculated by adding all the values in the particular row. After that the ratio of weighted sum value to the criteria weight are calculated for each row. By considering the average of these values the lambda max is calculated. Then consistency index (CI) and consistency ratio are estimated.

$$\lambda_{max} = \frac{\text{Weighted Sum Value}}{\text{Criteria Weight}} \quad \text{..... (1)}$$

$$\text{Consistency index (C.I)} = \frac{\lambda_{max} - n}{n-1} \quad \text{..... (2)}$$

To estimate the Consistency Ratio, Random Consistency Index (RCI) is considered which is the consistency index of randomly generated pair wise matrix.

$$\text{Consistency Ratio} = \frac{\text{Consistency Index (C.I)}}{\text{Random Consistency Index (R.C.I)}} \quad (3)$$

The obtained criteria weights are considered as correct when the consistency ratio is less than 0.1.

3.2 TOPSIS Method

TOPSIS (Technique for order preference by similarity to ideal solution) is established on the idea of finest alternative should have the shortest distance. That is the best distance from the ideal solution. This research deals with the selection of best blend out of all 5 alternatives and for which the CO%, HC (ppm), CO_2%, O_2%, NOx ppm, Smoke Mg/m3, BTE and Sfc (Kg/KWh) are considered as criteria.

The process of TOPSIS technique is as follows:

Step 1: Normalization of the evaluation matrix:
It is aimed to convert various units in different criteria into common units to allow comparisons among the criteria.
For the alternative j on criterion I, of normalized values of alternatives X_{ij} X_{ij} is defined as follows:

$$\overline{X_{ij}} = \frac{x_{ij}}{\sqrt{\sum_{i=1}^{n}(x_{ij})^2}}, \; i = 1,2,\ldots,m; \; j = 1,2,\ldots,n. \quad (4)$$

Step 2: creating a weighted normalized decision matrix:
The weighted normalized decision matrix can be prepared by multiplying the normalized evaluation matrix X_{ij} with its associated weight W_j to obtain the result.

$$V_{ij} = \bar{X}_{ij} \times W_j \quad (5)$$

Step 3: Determination of the positive and negative ideal solutions:
The positive ideal solution V_i^+ shows the utmost better alternative and the negative ideal solution V_i^- indicate the least desirable alternative.
V_i^+ is maximum value as a best alternative for beneficial and minimum value as non-beneficial.
V_i^- is minimum value as a worst alternative for beneficial and maximum value for non-beneficial.

Step 4: Calculation of the separation measure:
The separation from the positive and negative ideal for each alternative can be measured by the n-criteria Euclidean distance.

$$S_i^+ = \sqrt{\sum_{j=1}^{m}(v_{ij} - v_j^+)^2} \quad (6)$$

$$S_i^- = \sqrt{\sum_{j=1}^{m}(v_{ij} - v_j^-)^2} \quad (7)$$

Step 5: Calculation of the relative closeness to the ideal solution or Performance score:

The relative closeness of the i^{th} alternative with respect to ideal solution V+ is defined as

$$P_i = \frac{s_i^-}{s_i^+ + s_i^-} \quad (8)$$

Step 6: Ranking the priority:
A set of alternatives then can be preference ranked according to the descending order of Pi.

Table 2. Pairwise comparison matrix for main criteria

	C1	C2	C3
C1	1.000	3.000	5.000
C2	0.333	1.000	3.000
C3	0.200	0.333	1.000

Table 3. Final criteria weights

Main Criteria	Global Weights	Sub-criteria	Final Criteria Weights
C1	0.633	C11	0.304
		C12	0.257
		C13	0.073
C2	0.260	C21	0.165
		C22	0.028
		C23	0.068
C3	0.106	C31	0.071
		C32	0.009
		C33	0.026

At the end of the AHP method, the most important criterion is found to be the "Customer satisfaction (C11)". The second important is "Customer loyalty (C12)" and the third ranked factor is "Image (brand value) of company (C21)".

3.3 Evaluation of Digital Marketing Technologies with TOPSIS Method

Table 4. The weighted normalized decision matrix

	C11	C12	C13	C21	C22	C23	C31	C32	C33
A1	0.184	0.238	0.021	0.094	0.002	0.018	0.021	0.004	0.019
A2	0.026	0.048	0.007	0.056	0.016	0.041	0.035	0.006	0.003
A3	0.184	0.048	0.035	0.056	0.007	0.029	0.049	0.003	0.013
A4	0.079	0.048	0.035	0.056	0.007	0.029	0.021	0.003	0.008
A5	0.132	0.048	0.049	0.094	0.02	0.029	0.021	0.004	0.008

Table 5. The ranking of the alternatives

	S_i^+	S_i^-	P_i	Rank
A1	0.162086	0.197773	0.549584	**1**
A2	0.196319	0.164709	0.456222	**2**
A3	0.252244	0.035341	0.12289	**5**
A4	0.205769	0.106841	0.341771	**3**
A5	0.224433	0.068015	0.232571	**4**

Ultimately, “Artificial Intelligence (A1)” has become the most appropriate digital marketing technology among five alternatives with the final performance value of 0.549584.

IV. CONCLUSION

The pace of technological development and renewal is increasing at an ever-increasing rate. Technology's increasing rate of development has led to alterations in marketing strategies. Public relations can be given a significant boost thanks to the widespread adoption of digital technology in marketing. There are many competing goals and numerous parameters to consider when evaluating digital marketing technologies. An evaluation framework for digital marketing technology using MCDM methodologies is the goal of this study.

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