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- *What is the research question?*

WHY?

Literature Review

Methods

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HOW?

Results

- What was the answer to the question?
- This is often shown in tables and figures.

WHAT?

Discussion/
Conclusion

- What is the significance of this project?
- How does it fit in with what else is known about the topic?

SO WHAT?

References

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Irena Pletikosa Cvijikj · Florian Michahelles

Title

- Clearly describe the subject of the paper

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Abstract

- Summarize

Abstract Social networks have become an additional marketing channel that could be integrated with the traditional ones as a part of the marketing mix. The change in the dynamics of the marketing interchange between companies and consumers as introduced by social networks has placed a focus on the non-transactional customer behavior. In this new marketing era, the terms engagement and participation became the central non-transactional constructs, used to describe the nature of participants' specific interactions and/or interactive experiences. These changes imposed challenges to the traditional one-way marketing, resulting in companies experimenting with many different approaches, thus shaping a successful social media approach based on the trial-and-error experiences. To provide insights to practitioners willing to utilize social networks for marketing purposes, our study analyzes the influencing factors in terms of characteristics of the content communicated by the company, such as media type, content type, posting day and time, over the level of online customer engagement measured by number of likes, comments and shares, and interaction duration for the domain of a Facebook brand page. Our results show that there is a different effect of the analyzed factors over individual engagement measures. We discuss the implications of our findings for social media marketing.

Keywords Social networks · Facebook · Social media marketing · Online engagement · Interaction

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1 Introduction

Marketing has recently undergone significant changes in the way information is delivered to the customers (Mangold and Faulds 2009). Social networks (SN), as a part of Web 2.0 technology, provide the technological platform for the individuals to connect, produce and share content online (Boyd and Ellison 2008). As such, for brand owners, they offer the potential for (1) advertising—by facilitating viral marketing, (2) product development—by involving consumers in the design process, and (3) market intelligence—by observing and analyzing the user generated content (UGC) (Richter et al. 2011).

The rise and continued growth of SNs have attracted the interest of companies who see the potential to transmit their marketing messages to the customers and enter into a dialogue with them using the word-of-mouth (WOM) principles. They have evolved their customer approach, shifting from traditional one-to-many communication to a one-to-one approach and offering contact or assistance at any time through SNs such as Facebook, Twitter, MySpace, etc. (Hanna et al. 2011). Using Facebook as an example, this means that companies set up and moderate a Facebook brand page, while continuously monitoring the consumers' activities. As an outcome of this change in the field of marketing, a new phenomenon, generally known as social media marketing (SMM) was introduced.

Social media marketing, a form of WOM marketing, but also known as viral marketing, buzz, and guerilla marketing is the intentional influencing of consumer-to-consumer communication through professional marketing techniques (Kozinets et al. 2010). This is not to be seen as a replacement for the traditional marketing techniques but rather as an additional marketing channel that could be integrated with the traditional ones as a part of the

Prob. statement/
motivation

Research gap

Objective

Structure of the work

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marketing mix. The advantage of this new electronic channel is that it can be used to communicate globally and to enrich marketing toward consumers at the personal level (Mangold and Faulds 2009). Through users' feedback or by observing conversations on social media, a company can learn about customers' needs, potentially leading to involvement of members of the community in the co-creation of value through the generation of ideas (Palmer and Koenig-Lewis 2009).

Despite the general popularity, viral marketing on SNs has not yet reached the high expectations set (Clemons et al. 2007). Although many SMM channels have already been created, how these channels are being used, what their potential is and how consumers interact remains largely unknown. A structured, academic analysis in this field is still outstanding and has yet to be addressed from different perspectives (Richter et al. 2011).

To contribute in this direction, in this paper we analyze the factors that influence the level of online customer engagement on SMM channels. We focus on two basic elements of the company's engagement plan: (1) which content should be posted to trigger higher level of online engagement and (2) when the content should be posted. To answer these questions, we evaluate the effect of the content characteristics, such as (1) media type, (2) content type, (3) day and (4) time of posting, over the level of online engagement on a Facebook brand page. We measure the engagement level through (1) the number of likes over the content created by the company, (2) number of comments, (3) number of shares and (4) interaction duration.

The continuation of this paper is structured as follows: Section 2 provides an overview of the related work. Section 3 introduces the concept of a Facebook brand page. Section 4 constructs the conceptual framework and derives the hypotheses. Section 5 describes the used methodology. The results of the analysis are presented in Sect. 6, while Sect. 7 discusses the findings and draws implications for practitioners. We conclude the paper with Sect. 8.

2 Related work

2.1 Social networks

A SN can be defined as "web-based services that allow individuals to (1) construct a public or semi-public profile within a bounded system, (2) articulate a list of other users with whom they share a connection, and (3) view and traverse their list of connections and those made by others within the system" (Boyd and Ellison 2008). Since their introduction in 1997 with SixDegrees.com, SNs have

writing, Facebook is the largest SN with more than 955 million active users (Facebook 2012a) and the most visited page on Internet (Alexa 2012).

Social networks and Facebook have been studied from different perspectives such as the network structure (Caci et al. 2012), characteristics of the users (Bhattacharyya et al. 2011; Hargittai 2007; Karl et al. 2010), usage patterns (Golder et al. 2007; Lampe et al. 2006), usage motivations (Joinson 2008; Raacke and Bonds-Raacke 2008), identity management and self-presentation (Labrecque et al. 2011; Zhao et al. 2008), social interactions (Kostakos and Venkatanathan 2010; Nazir et al. 2008), and privacy and information disclosure (Debatin et al. 2009; Krasnova et al. 2009). In addition, specific usage contexts were analyzed, such as utilization of SN for knowledge exchange in academia (Ferri et al. 2012), the value of SNs for politics environment (Stieglitz and Dang-Xuan 2012), etc. However, little has been published about the use of SNs in the context of companies, though SNs can be applied in three distinct areas: "(1) recruiting and professional career development, (2) relationship facilitation in distributed work contexts, and (3) business-to-customer interactions" (Richter et al. 2011). It is the business-to-customer (B2C) interactions on SN platforms that are in the focus of this paper.

2.2 Brand communities and consumer engagement

Social networks represent a natural technological platform for marketing, providing access to a large number of users, grouped in non-geographically bound communities, based on a structured set of social relationships among admirers of a brand, i.e. brand communities (Muniz and O'Guinn 2001).

Brand communities were found to be a successful tool for increasing sales (Adjei et al. 2010; Bagozzi and Dholakia 2006). In addition, they have the potential of improving the relationship between the consumers and the brand (Sicilia and Palazon 2008) and may influence members' perceptions and actions (Muniz and Schau 2007).

Brand communities facilitate interactions through exchange of opinions about the brand or a particular product among consumers, thus engaging their members in a form of WOM communication (McAlexander et al. 2002). WOM was found to be a powerful tool for marketing, frequently used by individuals as a source of brand or product-related information (Buttle 1998; Duana et al. 2008). As such it plays a significant role for increasing the brand commitment and purchase decision making (Harrison-Walker 2001; Richins and Root-Shaffer 1988), leading ultimately towards increase in sales (Godes and Mayzlin

Previous studies in the field of customer engagement in brand communities focused mostly on the consequences of engagement, including concepts of satisfaction (Bowden 2009), commitment and emotional attachment to the brand (Chan and Li 2010), empowerment (Cova and Pace 2006; Fuller et al. 2009), consumer value (Gruen et al. 2006; Schau et al. 2009), trust (Casalo et al. 2007; Hollebeek 2011), and loyalty (Andersen 2005; Casalo et al. 2007). Moreover, achieving these marketing objectives was found to be of significant importance for the companies, leading towards increased profitability (Enders et al. 2008; Hallowell 1996; Kumar et al. 2010). Thus, understanding the influencing factors which could increase the level of

More recent work has focused on empirical studies and particularly on ways companies may foster levels of customer engagement. Jahn and Kunz (2012) explore the factors that could convert consumers into loyal fans. In addition, De Vries et al. (2012) examine the popularity of brand posts, making an analogy between brand posts on Facebook and online advertising. Finally, an attempt to

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showed multiple lesions whereas HCC cases are reverse to that. The feature vector generated from the LBP Fourier features are fed to classifiers separately [1–3]. The automated system uses advanced imaging modalities and able to detect the diseases with better accuracy [3, 4]. Lesion segmentation, feature extraction, and disease classification are some of the popular stages of automated detection system. Various standard state-of-art method includes thresholding, clustering, contour and region based models, and machine learning algorithms have been reported to segment the cancerous tissues [5–8].

In a semiautomatic approach, Moltz et al. [6] used the thresholding with morphological processing to obtain the metastatic areas in liver. Chen et al. [7] presented a automated framework that utilizes algorithm for boundary detection for automatic recognition of the liver cancer and a neural network classifier with spatial gray-level co-occurrence matrix based features have been used effective classification of normal, hepatoma and hemangioma types of cancer. Gletsos et al. [8] classified healthy tissue, cyst, hemangioma and hepatocellular carcinoma categories of liver tumor using feed forward neural networks in 48 extracted texture features. Zhang et al. [9] presented an automatic

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els such as ACM are formulated in terms of a dynamic parametric contour. Substantially, the curve evolution of ACM can be converted to a level set formulation by embedding the dynamic contour as the zero level set of a time-dependent level set function (LSF) [10]. One advantage of level set methods is their representation of the contours of complex topology and their ability to handle topological changes such as splitting and merging in a natural and efficient way, which is not allowed in parametric active contour model. Although level set methods are used to solve a wide range of scientific and engineering problems, their applications are plagued with the irregularities of the LSF developed during the level set evolution [10]. When level sets expand to 3D space, they can be relatively slow to compute [11] and their formulation usually entails several free parameters that can be very difficult to tune correctly for specific applications.

1.3. Learning-based methods

Machine learning classification techniques, including supervised [12–14] and unsupervised (clustering or fuzzy clustering) [2,15–17], are also introduced into brain tumor segmentation. Trained classifiers estimate the probability for each voxel in the testing volume, judging whether the voxel belongs to the target or the background. The threshold of the probability map is calculated to obtain the segmentation result [2] or provide for post-processing [4]. These techniques make it possible for high-dimensional features to be utilized in order to achieve a better discriminatory power for tumors compared with sole dependence on intensity information [5]. Moreover, the approaches applied in the field of pattern analysis can be transplanted into medical image segmentation, such as distance metric learning algorithm [18,19], to make the intra-class samples closer while keeping extra-class samples as far away from each other as possible. Unfor-

Add new
reference(s)?



Paraphrasing

- ➡ Presenting an idea or argument in your **own words**.
- ➡ Citation?

Effectively preparing patients by dealing with questions, setting goals and making the patient feel involved ... (Lees, 2010, p.11).

Quotation

Continuing professional development allows people to ‘build on their knowledge and skills to develop their level of competence’ (Alsop, 2000, p.64).

Previous studies over temporal interaction patterns showed that most of the user activities on Facebook are undertaken during the workdays (Golder et al. 2007). Similarly, a study on online advertisement reported that the volume of CTR drops significantly over the weekend (Rutz and Bucklin 2008). Moreover, Facebook users were found to engage least during the morning and early afternoon, while the interaction increases towards the evening, reaching a steady high level during the night (Golder et al. 2007). Thus, if the post is created in the period when Facebook fans are active, i.e., peak (activity) hours, there is a greater possibility for the brand post to be seen on the wall, resulting in potential engagement over the post. Based on this reasoning, we propose the following two hypotheses:

H3a: Posts created on workdays result in higher level of engagement.

H3b: Posts created during the peak hours result in higher level of engagement.

5 The method

5.1 Data collection

Collection of the data for this study was performed using the customized scripts, based on the Facebook Graph API (Facebook Developers 2012). The Graph API provides access to Facebook social graph via a uniform representation of the objects in the graph (e.g., people, pages, etc.) and the connections between them (e.g., friends, content, etc.). For purposes of this study, we have used the posts connection of the page object. Posts connection represents a list of all post objects shared by the page moderator(s). Each post contains the following details relevant for this study: (1) the message, (2) post media type, (3) number of likes, (4) number of comments, (5) number of shares, (6) creation time, and (7) time of last interaction, corresponding to the time of creation of the last comment. The above listed elements extracted from the Facebook Graph API were stored in a relational database for further investigation.

The gathered dataset consists of posts obtained from 100 sponsored brand pages (see Table 4 Appendix). The criteria applied for selecting the set of brand pages consisted of (1) official brand pages created by the companies, (2)

analytics companies, Social Bakers (2012), FMCG is the industry domain which has attracted the largest number of brand community members on Facebook, at the same time having the lowest level of engagement.

To select the best players on the underlying platform, pages were selected using the Fan Page List web page (Fan Page List 2012) which ranks the Facebook pages according to several metrics. For this study, we have selected the number of fans as a success criterion. The complete list of selected pages and their high-level characteristics are provided in Table 4 Appendix.

In order to guarantee accuracy of the data and ensure independence from potentially changing Facebook policies, posts were fetched on a daily basis over the course of 2 months, from January to March 2012. For the selected period of time, 5,035 moderator posts were obtained. Due to the different engagement possibilities, posts in a form of Facebook polls were not taken into consideration for this study.

5.2 Operationalization of the variables

5.2.1 Independent variables: moderator post categorization

Content type: In order to assign the content type categories to the posts created by page moderators, we performed manual coding, following the coding development strategy (Glaser and Strauss 1967).

In the category entertainment, we included those posts which were not referring to the brand or a particular product. Instead, entertaining posts were written in a form of teaser, slogan, or word play, most of those explicitly asking for an engagement from fans, e.g.,

“Fill in the blank: Today would be perfect if ____”.
(source: Pizza Hut, 28.01.2012)

As informative posts we selected those that were given in form of traditional advertisement, thus containing information about specific products, brand, or the company, e.g.,

“Spice up your breakfast with our new Cinnamon Streusel Cakes, available now in single serve! [...]”
(source: Little Debbie, 26.01.2012)

Finally, to address H1c, we looked into the posts in a form of sweepstakes organized within the Facebook brand

Equations

The cost function of the FCM algorithm is defined in Eq. (1)

$$J = \sum_{n=1}^N \sum_{m=1}^C \mu_{mn}^l \|i_n - v_m^2\|, \quad (1)$$

where l is the controlling parameter with value ($l > 1$). The membership functions are subject to the subsequent constraints

Here p and q are the two controlling parameters and the variables h_{mn} incorporates the spatial information which is given by the Eq. (5)

$$h_{mn} = \sum_{k=N_n} \mu_{nk}. \quad (5)$$

Figure

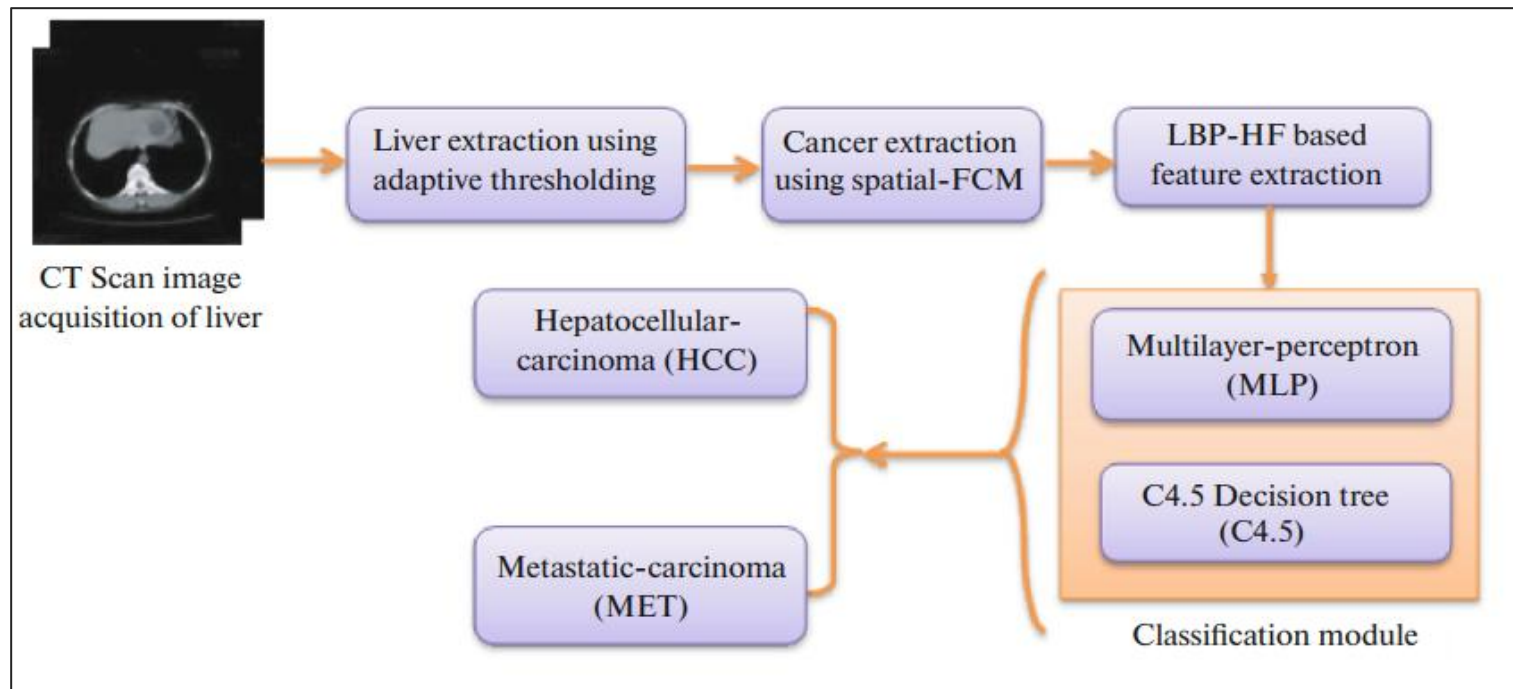


Fig. 2. Flow diagram of the proposed automated liver cancer detection system.

The CT image includes three types of phases: non-contrast enhanced phase, arterial phase and portal phase. HCC are small lesions and will appear in the arterial phase only whereas MET appears in multiple lesions and occurs in all three phases. The flow diagram of the proposed automated detection method is shown in Fig. 2. It consists lesion segmentation, feature extraction and classification. The cancerous region was segmented using SFCM algorithm subsequently feature were extracted and classified with clas-

Table

Table 1. DICE score for the single test data sets.

Dataset	Complete tumor	Tumor core	Enhancing tumor
HG0301	0.85	0.87	0.79
HG0302	0.83	0.74	0.85
HG0303	0.86	0.78	0.74
HG0304	0.75	0.63	0.53
HG0305	0.88	0.73	0.69
HG0306	0.82	0.58	0.63
HG0307	0.81	0.47	0.48
HG0308	0.89	0.89	0.66
HG0309	0.75	0.50	0.68
HG0310	0.88	0.86	0.80
mean:	0.83 ± 0.048	0.71 ± 0.144	0.68 ± 0.113

BRATS 2013 data set via the BRATS online tools [4]. The leaderboard data set consists of 21 high-grade and 4 low-grade glioma subjects and the challenge data set consists of 10 high-grade glioma subjects. The results are shown in Table 1. The performance measures include Dice scores, positive predictive value (PPV), and sensitivity for three interest regions: whole (complete abnormal regions including tumor and edema), core (tumor regions), and active (enhancing regions).

duration, represent count variables with a Poisson distribution. In addition, since the distribution variance and mean were different for all of the dependent variables, we used a Negative Binomial estimation method which overcomes the problem of overdispersed count data (Cameron and Trivedi 1998). Thus, the model to explain the engagement over moderator posts can be expressed as

$$\log(y_i) = b0_i + \sum_j b1_{y_i \text{content type} j} + \sum_j b2_{y_i \text{media type} j} + b3_{y_i \text{workday}} + b4_{y_i \text{peak hour}} \quad (6)$$

Within the formula (6), y_i refers to the likes ratio, comments ratio, shares ratio, or interaction duration. Of the remaining variables, content type indicates the presence of a particular content type in the post. Similarly, media type indicates the presence of a particular media type in the post. Further, workday indicates that a post was created on workday, and peak hour indicates that the post was created during the peak hours.

($M = 0.000509$, $SD = 0.000969$) compared to commenting ($M = 0.000122$, $SD = 0.000308$) and sharing ($M = 0.000045$, $SD = 0.000601$).

In terms of the interaction duration, the average value was found to be 12,926.34 min ($SD = 16,274.68$). Details of the descriptive statistics are provided in Table 5 Appendix.

6.2 Model evaluation

Empirical results obtained from the estimation of the proposed model for engagement over moderator posts are presented in Table 1.

As shown in Table 1, the proposed model for the likes ratio is significant as a whole (LR χ^2 (8, $N = 5,035$) = 814.183, $p < 0.0001$). The same applies for the comments ratio (LR χ^2 (8, $N = 5,035$) = 996.493, $p < 0.0001$), shares ratio (LR χ^2 (8, $N = 5,035$) = 1,035.499, $p < 0.0001$), and interaction duration (LR χ^2 (8, $N = 5,035$) = 258.225, $p < 0.0001$). In addition, different effects of independent variables were found to exist over individual engagement measures. Details of the obtained results for each of the analyzed factors are presented in continuation.

6.2.1 Content type

Content type was found to be a significant factor for all measures of engagement: the likes ratio (LR χ^2 (3,

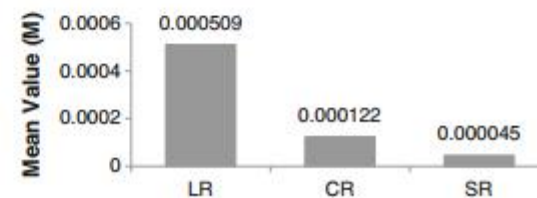


Fig. 3 Mean values of engagement measures within the observed dataset

Results and discussion

6 Results

6.1 Descriptive statistics

To gain a general understanding on how are Facebook brand pages utilized we first looked into the descriptive statistics for the selected factor variables.

In regard to the shared content, posts containing entertainment were most frequently used by page moderators (2,948 occurrences, 58 % of total). These were followed by posts providing brand-related information with 698 occurrences (14 %), while remuneration occurred in 387 posts (8 %). In terms of media type, posts in form of photos were the most frequently used (2,032 occurrences, 40 % of total), followed by status posts (1,842, 37 %), links (688,

I_{3B}: Facebook brand page moderators should focus on vivid content, i.e., videos, photos, and links to increase the reach of their message, by stimulating the sharing activity of the fans.

7.3 Posting time

Posting weekday was found to be a significant factor for the engagement level in terms of likes and comments ratios. Still, positive effect occurred only over the commenting activity, while a small negative effect was found to exist over the liking activity. In addition, no effect occurred in regard to sharing and interaction duration. Since commenting requires more time than liking and sharing (which only requires one click), we might assume that people are willing to spend this time on the days when they use Facebook with greater intensity, i.e., on the workdays.

Thus, due to the fact that we were not able to fully confirm our hypothesis, we could only recommend

I_{4A}: Facebook brand page moderators should post on workdays to increase the number of comments.

Opposite to the expected, posting in the peak activity hours was found to have a negative effect over the liking and sharing activity. Positive effect was found to exist only over the interaction duration, while commenting activity is not influenced by posting time. One possible explanation might be that during the peak hour fans give the priority to the engagement with their friends which would comply with previous finding over the motivations for usage of SNs (Raacke and Bonds-Raacke 2008). Thus, the managerial implication to be drawn from the obtained result is

I_{4B}: Facebook brand page moderators should post during the low hours to increase the level of engagement through liking and sharing.

7.4 Page sub-category

gain knowledge about the specific characteristics and interests of their own brand communities, which enables fine-tuning of the initially established SMM engagement strategy.

8 Summary, limitations, and future work

In this paper, we analyzed the characteristics of the content created by companies as factors that might influence the level of online engagement on Facebook brand pages, used as a platform for SMM. We developed a model which explains the relationship between these constructs. Our results showed that providing entertaining and informative content significantly increases the level of engagement. In addition, fans positively react to content offering remuneration but only in a form of commenting. We also showed that vividness increases, while interactivity decreases the level of engagement over moderator posts, making photos the most appealing post media type. Finally, posts created on workdays increase the level of comments, while posting in peak activity hours will reduce the level of engagement. These findings should encourage moderators of Facebook brand pages to prepare engagement strategies that trigger the activity of fans and drive brand adoption in the long run.

The results presented in this paper are limited to Facebook brand pages as SMM platform. As such, the concept of engagement investigated in this paper is limited to online engagement and reflects the selection of Facebook as an underlying technological platform. In addition, the existence of friendship between the fans as a factor that might influence the level of engagement is not taken into consideration due to the inability to obtain such information from Facebook, as a result of the limitations imposed by the existing privacy policies. Finally, the analysis was conducted only over the food/beverages category of Facebook brand pages, thus limiting the industry domain to FMCG.

In order to confirm our findings or identify specific

Conclusion

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