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Using cognitive systems in marketing analysis

Abstract. Social media resources currently contain vast amount of unstructured data, open for processing with marketing analytics tools. Due to existing cognitive systems, we can uncover and handle interdependencies within unstructured data, turning them in structured ones. Cognitive computer systems are rapidly evolving and have a big potential to change the way information is used in business applications. Evolution of the cognitive information systems is still ongoing, yet they are already used in business and marketing. The goal of our article is to define various ways to apply cognitive systems for unstructured data analysis and management for further use in marketing analytics. We will use IBM Analytics Tools for the example of cognitive computing. We apply these tools to analyse social media as one of the major sources of data on potential customers. Social media is among the fastest growing communication platforms. At the same time, it is the venue for most swift and immediate reactions by customers to various marketing activities. Analysis of such type of data therefore provides interesting and important information on how people perceive different commercial products.
Via IBM Watson we were able to analyse unstructured data found on social media. The advantage of using cognitive system is that system itself collects the relevant data, which we wanted to analyse, based on preset criteria. Analysis of data from the set of social media provided us with information on frequency of references to and individual perceptions of certain brands. Furthermore, from social media we also learned about demographic and geographical spread of awareness about brands and products. For research we analysed the perception of price of a new Samsung product (Samsung Galaxy S7) among students (age group 18-25) during two months from its launch (from 03.01.2016 to 04.30.2016).
Keywords: Cognitive Computing; Hadoop; IBM Watson Analytics; MapReduce; Marketing Analysis; Semantic Web
JEL Classification: M31
Acknowledgement. *This paper is the result of research under the grant scheme 2015-PSD-PAV-02 «Increasing the effectiveness of marketing on social media through automation tools».*
DOI: https://doi.org/10.21003/ea.V160-11

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Використання когнітивних систем у маркетинговому аналізі

Анотація. Соціальні медіа в сучасному світі є одним із найбільших джерел неструктурованих даних, обробка та аналіз яких становить суттєвий виклик для засобів аналізу ринку. Здатність когнітивних комп'ютерних систем викривати взаємозв'язки між даними та використовувати їх у подальшій обробці інформації роблять такі засоби ефективним інструментом для роботи з неструктурованими даними.
Автори статті демонструють на прикладі застосування системи IBM Watson та IBM Analytics Tools можливості сучасних когнітивних систем обробляти великі масиви неструктурованих даних, що містяться в соціальних медіа, та отримувати інформацію щодо просування товарів і послуг на ринку. Проведений авторами експеримент продемонстрував ефективність IBM Watson у проведенні прикладних маркетингових досліджень із просування товарів на ринку, на якому споживачі при виборі товарів і послуг враховують оцінки та думки, сформовані у соціальних медіа.
Ключові слова: когнітивні обчислювальні системи; Hadoop; IBM Watson Analytics; MapReduce; аналіз ринку; семантичні мережі.

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Использование когнитивных систем в маркетинговом анализе

Аннотация. Социальные медиа в современном мире являются одним из крупнейших источников неструктурированных данных, обработка и анализ которых является важной задачей для средств анализа рынка. Способность когнитивных компьютерных систем раскрывать взаимосвязи между различными данными и использовать их в дальнейшей обработке информации определяют их значимость в качестве инструмента обработки неструктурированных данных.
Авторы статьи продемонстрировали возможности современных когнитивных вычислительных систем (на примере системы IBM Watson и IBM Analytics Tools) обрабатывать большие массивы неструктурированных данных, содержащиеся в социальных медиа, и получить информацию о продвижении товаров и услуг на рынке. Проведенный ими эксперимент продемонстрировал эффективность IBM Watson для осуществления прикладных маркетинговых исследований в условиях, когда потребитель при выборе товара в значительной степени учитывает мнения и оценки, сформировавшиеся в социальных медиа.

Ключевые слова: когнитивные вычислительные системы; Hadoop; IBM Watson Analytics; MapReduce; анализ рынка; семантические сети.

1. Introduction

Enterprises need to focus their activities on innovative solutions to meet the challenges of technological progress, such as e-commerce, cloud computing, mobile technologies, Big Data processing, increased number of generating data applications (internet of things, social media, and cognitive solutions), which are defining contemporary business strategies and competitive market position. Husek (2016) states that it is crucial to implement new technologies and ICT for small and middle-sized companies. Companies have to react on changing preferences and expectations of customers. A brand new business environment arises, and promotes new possibilities and opportunities.

IBM predicted that IT business will focuses on social media and organizational structure of companies in the upcoming years (Epicor, 2013 [9]). The significant element in these areas is the production of vast amount of data which can be processed by cognitive systems. According to Stritensky, Stranska & Drabik (2013) [21], application of in-depth analysis of data from social media and providing ready to use reports for managerial decisions are especially useful for setting the communication strategy and for the crisis communication. These applications can be also used to manage effectively communication campaigns, because, as Miklosik notes, social media and search engine rankings are highly interconnected in the current search-centric marketing (Miklosik, 2016 [16]). Computers should use five senses like humans do. First one is to touch, as a computer, with help of infrared sensors and vibration testing, should tell us which material the shirt is made of, for example, whether it is real cotton or not. Using visual abilities of cameras installed on various devices is normal at present, but with the use of so-called «augmented reality» we can dig more detailed information and data from pictures or videos. A picture of a building can be, for example, added with the information of the date the picture was taken, approximate number of people in it, GPS coordinates and so on. The sense of taste is a bit complicated for computers to analyze. Combining food chemistry and psychology of tastes of humans, computers will be able to prepare food for particular person according to its health condition. The sense of hearing will be replicated by the microphone and with the use of the database of sounds, computers will evaluate the risk of possible threats and moods of the person, then computer system can recommend an action to be taken. The last sense is the smell. Millions of molecules can be analysed from the air or breath, and therefore their impact on health of an individual can be predicted.

The key factor of computer systems in an analysing process is the amount of data. An astonishing amount of data has been produced in the past two years, and its volume is still increasing. According to Adastra, 80% of data on Internet consist of text data from e-mails, CRM systems or social media. There is a big potential for each company to process these structured and unstructured data (Adastra, 2016 [2]). Giant leaps in evolving of computer systems open the door to brand new cognitive solutions which incorporate artificial intelligence abilities. Development of cognitive systems in computer science is an effort to simulate the function of human brain in both aspects – decision-making and information processing, and speech communication (Wladawsky-Berger, 2013 [23]). Cognitive computer systems will be dependent on development of neural networks, which can simulate the function of human brain.

IDC (IDC, 2015 [13]) predicts, that until 2020, 50% of all business analytics' systems will use cognitive computing functions. According to Forrester (2015) [10], automated data processing should replace manual one already in 2016. Also, the overall costs on self-service automation process will increase 2.5 times faster than traditional tools used in IT (Purnell, 2016 [17]).

2. Brief Literature Review

Different data types and Big Data

Hurwitz, Nugent, Halper & Kaufman (2013) [11] state that data types handled by IT systems could be divided into structured and unstructured ones, or mixed and mutually interconnected. Structured data have predefined format, length, and usually are stored in databases. Source of these data can be RFID sensors, GPS data, barcodes, logs from servers, or registration data entered into web forms. Unstructured data do not have any internal structure nor format, thus cannot be easily categorized. Examples of such data are photos, videos, e-mail texts, social networks discussions, blogs, web sites etc.

On the market, there are few tools able to process and evaluate unstructured data, like MapReduce[1] or Hadoop.[2] Their task is to process large amount of data in a short period of time, using massive parallel data processing. The Hadoop is based on data processing on one server with the possibility of extension on hundreds or thousands of servers with the great failproof ability. Hadoop can be applied for non-real time data handling because of its batch processing technology.

Dealing with a vast amount of data we approach new phenomenon of Big Data, extremely large data sets, hard to store, analyze and process. There is now universally applied criteria for labelling data object is as Big Data, usually we refer to this

[1] MapReduce algorithm designed by Google for parallel processing of large data volumes (BigData)
[2] Apache Hadoop is an open source software project that allows distributed processing of large amounts of data across clusters of commodity servers.

term to point out high complexity of processing data sets with standard tools in a reasonable period of time. Kataria & Mittal (2014) [14] state that data sets in Big Data can range from tens of terabytes to petabytes. The term Big Data is used properly in this context because users and «Internet of things» produce vast amounts of data. According to Ahrary & Ludena (2014) [2], the IoT technology integrates with the Big Data to regulate smart industrial automation. Almost all data generated by IoT are saved in big storages for further processing, analyses and extraction of value. Industrial automation systems generate a large amount of data daily. For example, typical provincial electricity grid in China generates one terabyte of data daily, collected in 5-15 minutes intervals (Accenture, 2014 [1]).

Rapidly growing amount of data on the Internet is paving the way for systems with cognitive abilities, searching for interconnections and structures in unstructured data. Cognitive systems with artificial intelligence are self-learning. Therefore they are more suitable for analysis and adaptive solutions than hard-coded software. Cognitive sciences in computer technology are being called cognitive computing, which consists of self-learning, understanding of human speech, genetic algorithm, brain simulations and so on (Ryba, 2014 [19]). According to Reynolds & Feldman (2014) cognitive systems can be defined as follows:

- Ability to process Big Data from heterogeneous sources;
- Dynamical and adaptive learning from permanently changing information;
- Probabilistic - discovering new patterns based on context, creation of the hypothesis based on evidences;
- Highly integrated - automated systems on workplaces where particular modules are managed from one central system, which processes new data and compares it with historical data;
- Meaning-based - data processing with use of natural language, semantics;
- Highly interactive - tools for communication and interaction with human, tools for analysing and visualization of data [18].

Cognitive computing relies on identification of observations and information, which an individual with the best analytical thinking could not notice. This technique helps companies identifying new opportunities which can lead to better results in competing with other companies. Therefore some organizations from industries such as health, science, government and banks use the abilities of cognitive computing to face their biggest challenges.

Semantic web

Step towards self-learning can be found already in web-oriented services, where information content is adjusted both to human and computer usage. Search engine optimisation (SEO) of web pages assigns indexes in HTML code and their content becomes more readable for search engines. In this case we are talking about so called semantic web, which is readable not only for humans but also for computers. Main effort is focused on how machines understand a published article, to unable machine to make its own judgement. Here we are approaching Ontology engineering, the area in machine processing of information which represents a comprehensive dataset of particular domain (in the case of web pages, it is the dataset of rules which enables machine to extract new information from the known one). Figure 1 presents a very simplified example, where John and Janette share the same parents so the machine is able to evaluate their mutual relationship as siblings.

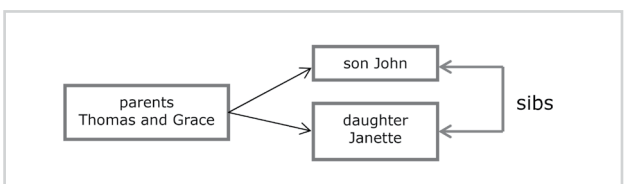

Fig. 1: **New information derived from the existing one**
Source: Elaborated by the authors

Over the past few years, a couple of ontology languages have been developed which can be applied in semantic web. Some of them are based on XML, e.g. Ontology Exchange Language (XOL), SHOE (which was based on HTML) and Ontology Markup Language (OML) (Bisco, 2005 [5]).

The XML is a low-level tool able to handle various problems. Its advantage is the ability to describe mutual relationships among data, but the description language is too complex and there is no standard for describing data with pure XML. Therefore it is necessary in case of mutual information exchange to use DTD (Document Type Definition) to describe the type of exchanged data. The next steps in the evolution are languages RDF and RDF schema, which were created by the W3C consortium. Unlike the XML, RDF can describe the structure of data as well as data themselves. RDF schemas allow to create RDF structures, where hierarchy of concepts could be defined (Babjak, 2004 [4]).

RDF language was created for modelling, description and exchange of data sources (Figure 2). It uses a simple data model to describe sources and source types. Source type is described by Triplet (Subject, Predicate, Object) (Durech, 2008 [8]).

Semantic web due to its understandability gives an opportunity to approach another source of unstructured data on Web. Internet of things also contains vast amount of unstructured data where cognitive computers can discover new interdependencies, extract information and build predictions for the future.

```
<?xml version="1.0"?>
 <rdf:RDF xmlns:rdf="http://www.w3.org/1999/02/22-rdf-syntax-ns#"
       xmlns:rdfs="http://www.w3.org/2000/01/rdf-schema#">
 <rdfs:Class rdf:ID="Person">
  <rdfs:comment>Person Class</rdfs:comment>
  <rdfs:subClassOf
     rdf:resource="http://www.w3.org/1999/02/22-rdf-syntax-ns#Resource"/>
 </rdfs:Class>
 <rdfs:Class rdf:ID="Student">
  <rdfs:comment>Student Class</rdfs:comment>
  <rdfs:subClassOf rdf:resource="#Person"/>
 </rdfs:Class>
 <rdf:Property rdf:ID="name">
   <rdfs:comment>Name of a Person</rdfs:comment>
   <rdfs:domain rdf:resource="#Person"/>
   <rdfs:range rdf:resource="http://www.w3.org/1999/02/22-rdf-syntax-ns#Literal"/>
 </rdf:Property>
 </rdf:RDF>
```

Fig. 2: **RDF and RDF schema in practice**
Source: Elaborated by the authors

However, maybe the most interesting web-resource for data-wise is social media which have become so popular over the past few years. Social media platforms provide possibilities to analyse opinions and statements by people about products and services on the market. Song, Cheon & Lee (2014) [20] state that we can see so called «domino effect» with mass reaction on individual statements about some products. D'Avanzo and Pilato discovered that 80% of customers share opinions with their friends about products and services. These opinions have much higher relevance than expert opinions. According to D'Avanzo & Pilato (2015) [7] merchandisers take this fact into account and create space on their web-pages for sharing of information between customers. Social media have become unlimited source of information. Processing of such large amount of data requires smart IT systems with cognitive data analysis.

IBM Watson

IBM is one of the leaders in development of cognitive systems and artificial intelligence (AI), and its system named Watson is a flagship of AI applications. IBM Watson is a supercomputer system that combines artificial intelligence and sophisticated data analysis software. The supercomputer is named after the founder of IBM, Thomas J. Watson. It has data processing speed of 80 teraflops (trillions of floating points per second)

and access to 90 servers with multiple data storage. It has 200 million pages of information that are processed according to six million logic rules.

It incorporates IBM's DeepQA, designed for gathering information and includes software for language processing and machine learning. Future use of the IBM supercomputer Watson is not yet entirely clear, but we see processing of online information very promising, as this system can provide results unattainable for standard search engines.

3. Purpose and methodology

The goal of our article is to focus on using cognitive systems in analysing unstructured data. One of the major sources of data is social media. This source brings both objective data and subjective emotional reactions to surrounding reality. These emotions can be produced as a reaction to goods and services on the market. Therefore this source of data is suitable for marketing analysis. Analysing unstructured data could be very difficult but newly emerged cognitive systems may handle them.

To achieve the goals, the authors have applied both secondary and primary research methods. A case study was selected as a primary research method due to the possibility of further research of the subject. Based on previous research, the authors have identified social media as an interesting area of rapidly growing number of public unstructured data. New technological applications in cognitive computing allow processing unstructured data more effectively.

Secondary research was conducted with a quantitative method of querying the data source and analysing the results by IBM Watson. The actual analysis system used method of observation and finding mutual relations. We used secondary unstructured data identified by the queries in social media as data source.

Presentation of the results of the case study includes:

- Forming the investigative query on price of a new product («Samsung Galaxy S7») over a period of two months from its launch;
- Transforming the query into the IBM Watson system and setting the parameters;
- Analysing of outputs from the IBM Watson;
- Formulating conclusions.

4. Results

Analysis using IBM Watson Analytics

For research simulation, the authors decided to analyse the perception of price of a new Samsung product, Samsung Galaxy S7, during two months from its launch. We conducted a survey among students (age group 18-25) in a timeframe from 03.01.2016 to 04.30.2016. Results of our research could be interesting for companies involved in marketing of mobile communications' products. For use of IBM Watson and its modules for analysis of social media, a query specified in Table 1 has been defined.

A full range of unstructured data sources available in the free version of IBM Watson was used for the analysis, namely: Twitter, forums, reviews, videos, blogs, and news (Fig.3).

When analysing initial data, the system identified 10,812 documents of which the subsequent processing identified 5,494 relevant documents with search terms occurred in 6,384 cases. The IBM Watson Analytics generates results in the categories shown in the table 2.

The Topics category shows the occurrence of a relevant data during the two months that were selected for the case study. As seen in Figure 4, the release day of the product (March 8-14, 2016) can be easily identified by the increase in the number of mentions.

In the examined period (3/1/16 to 4/30/16) the authors were interested not only in the frequency analysis, but especially in the emotional load of the posts written: whether they were positive, neutral, negative or ambivalent (Figure 5).

Tab. 1: **Query definition**

Search terms*	Context**	Excluded terms *
Samsung galaxy s7	price	Samsung galaxy s6
Galaxy s7	sales	Samsung galaxy s5
Samsung s7		Samsung galaxy s4
		Samsung galaxy s3
		Samsung galaxy s2
		Samsung galaxy

* All alternatives have been used
** Slovak language was used in the queries
Source: Elaborated by the authors

Tab. 2: **Results in categories**

Topics	Share of voice and trend
Themes	Share of voice and themes by topic
Sentiment	Relative breakdown by topic
Geography	Share of voice around the world
Sources	Breakdown of topic by source
Active Authors	The 20 authors generating the most content
Demographic	Gender, marital and parental status

Source: Elaborated by the authors using IBM Watson Analytics

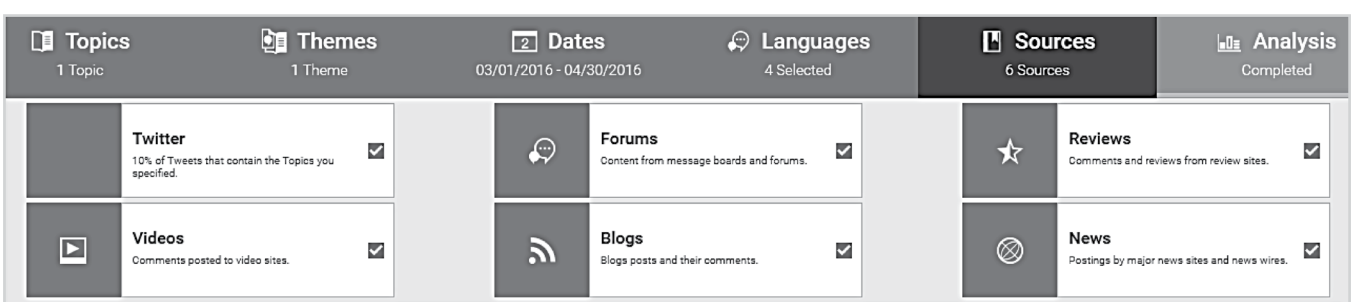

Fig. 3: **Data sources**
Source: Elaborated by the authors using IBM Watson Analytic

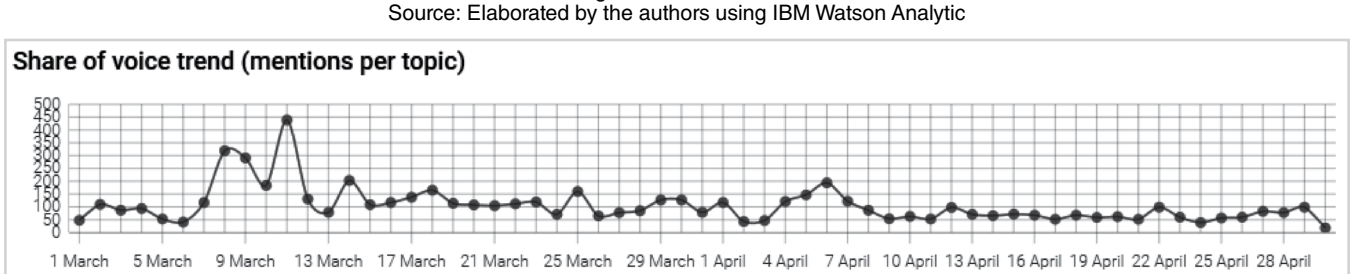

Fig. 4: **Share of voice trend**
Source: Elaborated by the authors using IBM Watson Analytics

It was found that neutral posts predominate, with the positive ones as the second.

Price of the analysed product was seen predominantly as positive, with a large percentage of posts having neutral stance on the price, which might be interpreted as perception of the price as adequate for the new product. For marketing analysis it is also interesting to look at the sources of data that IBM Watson Analytics identified as relevant and used for its analysis.

In the Figure 6 we can see the impact of marketing campaign on different social media platforms. Given the featured new product, it has highest exposure in news media, followed by online videos, which makes sense if you are addressing young generation, like we did in our study. Forums were on the third place (we can speculate that they contained most of immediate feedback and reaction to the new product on the market), followed by blogs. The only separately analyzed social network - Twitter - is ranked second to last. Placed last were expert reviews and articles.

Here we can provide interim analysis to evaluate effectiveness of marketing efforts in selected social media.

Other outputs that are provided by IBM Watson also include information on the demographic and geographic composition of the sample. Given the level of development of this system, both categories are only partially relevant. Only sources written in English, French, German and Spanish are taken into account. It should be added that at this point of evolution, social networks are represented only by Twitter, which is not the most widely used social network. IBM is constantly working on expanding data sources for its analytics.

5. Summary of the findings

In the case study presented, the authors have indicated various interesting possibilities of using cognitive computer system IBM Watson Analytics in marketing analysis. They can be summarized as follows:

- There is no need to use structured data in the analysis. Cognitive systems are able to get their own data mined from raw resources.
- Sources of analytical data handled by IBM Watson in the social media module include the data in an unstructured format that is currently generated in largest quantities. System can provide analysis based on context data as well.
- Processed outputs depict the overall perception of product in social media, provide feedback on the effectiveness of the marketing activities, and show where to focus new marketing campaigns.

The main benefits of marketing analysis is in the detection of long-term trends, avoiding past mistakes and use past successes (Lesakova, 2002, [15]). The future will show how cognitive computing systems will assist with strategic, economic and political decisions, thus accelerating global trends in formation of ideas and rationalization. Future IT services models will be based on cloud services growing with extended cognitive approach in applications and APIs, which will combine, filter, analyze and provide intelligent semantic content that is meaningful to the corporation and the employees themselves (Tolido, 2014 [22]).

According to IBM, 80% of the data generated during the past two years had the form of unstructured data - in the form of emails, articles, blogs, discussion forums, posts on social networks, and files in document format, HTML or PDF. In today's world of Big Data we need to process these unstructured data and acquire information that they provide. Deloitte (2015) [6] states that exactly such tasks are suitable for cognitive systems capable of handling large amounts of data.

6. Conclusions

The effectiveness of the IBM Watson depends greatly on the sources that it can analyze. In our case we had up-to-date news sources, but only Twitter was analyzed among social networks. This, together with the correct setting of filters for the examined sample, affects the relevance of the analyzed data. Being aware that the more specific the sample is, the more relevant the analyzed data are, we must not forget that the relevance of the analyzed data is also affected by the combination of terms that the system is looking for in the source data. IBM Watson is a cognitive system, which means it has the ability to self-learning from the source data and provides conclusions which further produce new context. The source data can also be a combination from different inputs, making it a complex system able to work with different variations of the input data without need for individual programming.

Cognitive systems like IBM Watson have big potential when used in advance to support the introduction of the product to the market, allowing monitoring how people in different geographic and demographic groups react to the product. It makes possible to adjust targeting of the product and address most appropriate audience in marketing campaign. IBM Watson is flexible and multipurpose cognitive system which can be used for research and analysis in economics and other areas of social life. For example, its cognitive ability to find new connections, and generate conclusions and forecasts allows using it in healthcare in diagnosis of complicated health problems. We would argue that the cognitive and self-learning abilities of IBM Watson are still much unexplored, and further work with this system will provide new discoveries and develop new applications.

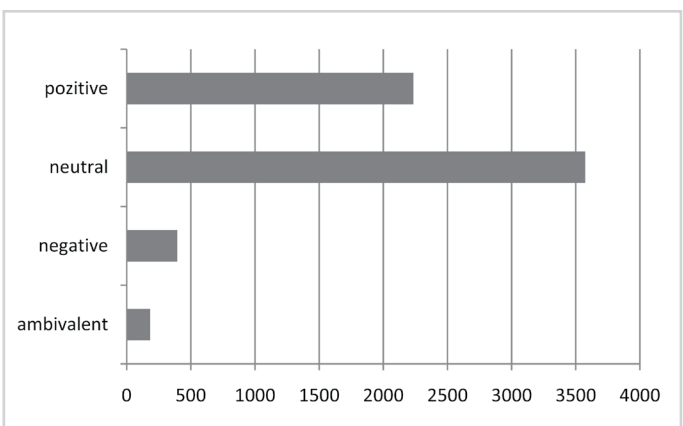

Fig. 5: **Sentiment of the posts**
Source: Elaborated by the authors using IBM Watson Analytics

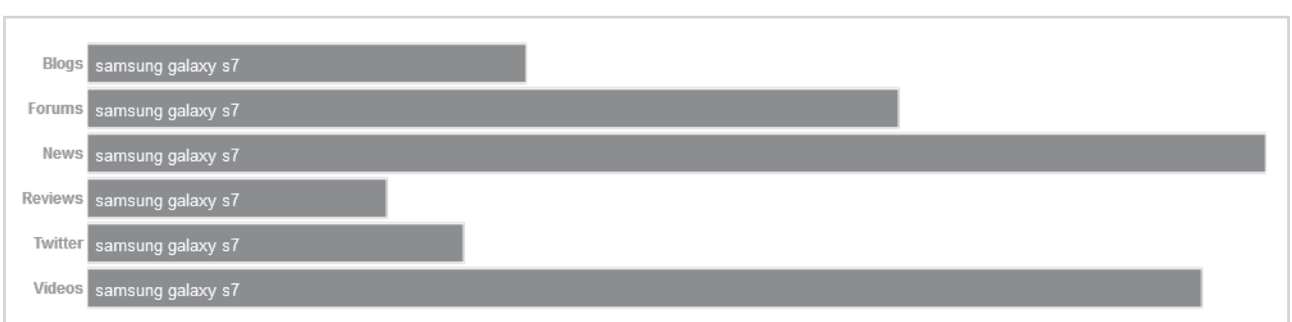

Fig. 6: **Social media source types**
Source: IBM Watson Analytics

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Received 3.05.2016