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Research & Innovation Forum 2019

Technology, Innovation, Education, and their Social Impact

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Editors

Research & Innovation Forum 2019

Technology, Innovation, Education, and their Social Impact

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Preface

Advances in sophisticated technology have an ever-growing impact on our societies, including communication, education, policy making, the modes of production, logistics, health care, entertainment, design, architecture, cities, etc. As the pace of technological advances accelerates, it is imperative that the dynamic nexus between technology and society is queried from a variety of perspectives. Only in this way we can identify not only nascent risks and emerging threats, but also the multiple opportunities that emerge. **Research and Innovation Forum** (**Rii Forum**) is driven precisely by this logic.

Research and Innovation Forum (**Rii Forum**) is an annual conference that brings together researchers, academics, and practitioners to engage in a conceptually sound, inter- and multi-disciplinary, empirically driven debate on key issues influencing the dynamics of social interaction today. The role of advances in sophisticated technology stands at the heart of discussions held during **Rii Forum**. Held annually, **Rii Forum** features in-depth cutting-edge research on both the most current and the emerging issues that unfold at the intersection of technology and society. The format of **Rii Forum**—consistent with traditional and flipped presentations, interactive workshops and featured roundtables—renders it a perfect venue to build bridges between the worlds of academia and policymaking to promote research-driven policy recommendations.

The **Rii Forum 2019** was held in Rome, April 24–26, 2019, and facilitated discussion, exchange of ideas, and networking. The **Rii Forum 2019** was attended by delegates from literally all over the world, including North and South America, Asia, the Arab Peninsula, and Europe. The conference opening speech was delivered by Dr. Akila Sarirete, Assistant Professor at the Computer Science Department and Dean for Graduate Studies and Research at Effat University, Jeddah, Saudi Arabia. Dr. Sarirete delivered a speech titled 'Fostering research, innovation, and education: the case of Effat University.' The kick-off speech during the second day of the conference was delivered by Dr. Saeed Ul Hassan, Director of Scientometrics Lab and Faculty Member at Information Technology University (ITU), Lahore, Pakistan. In his speech, Dr. Hassan addressed the question of 'How your research really matters?—Qualitative Assessment of Scholarly Impact using Citations from

full-text Scientific Literature.' The conference closing speech was delivered by Dr. Enric Serradell Lopez, Director of Executive Education, Open University of Catalonia, Barcelona, Spain. Dr. Serradell offered a captivating speech on 'Being an academic: re-thinking critical thinking.'

With regard to the research workshop, its goal was to build functional connections among the conference participants. The workshop was coordinated by Dr. Akila Sarirete, Dean of Graduate Studies and Research at Effat University. During the workshop, early career and established researchers had the opportunity to meet administrators, program and projects' administrators and explore the prospect of joint projects. Several research and collaboration schemes were discussed in detail during the workshop.

The cutting-edge quality of scholarly discussion during the **Rii Forum 2019** was possible due to an arduous review, selection, and double-blind peer-review process. Specifically, nearly 200 extended paper proposals from all over the world had been originally submitted to be presented during the conference. These proposals were reviewed by the **Rii Forum Program Committee** that accepted 90 paper proposals and notified respective authors. Eventually, 70 papers were presented during the conference, while 52—following a rigorous double-blind review process—are featured in this volume.

The structure of the volume mirrors the key topics around which **Rii Forum 2019** discussions oscillated, i.e.,

- Technology-enhanced learning,
- Cognitive computing and social networking,
- Smart cities and smart villages,
- Information systems,
- Medical informatics, and
- Emerging issues at the cross section of technology, politics, society, and economy.

In recognition of the amount of work invested and the resultant quality of research presented during the **Rii Forum 2019**, to highlight outstanding contributions and performance, following lengthy deliberations, **Rii Forum Program Committee** decided on granting of the following awards.

The **Rii Forum award for best Ph.D. student paper** was granted to Mr. Rafael Mollá Sirvent, supervised by Dr. Higinio Mora (University of Alicante, Alicante, Spain).

The **Rii Forum award for social impact** was awarded Petr Hořejší, Jiri Vysata, Lucie Rohlikova, Jiri Polcar, Michal Gregor (University of West Bohemia, Pilsen, Czechia) for their paper titled 'Serious Games in Mechanical Engineering Education.'

The **Rii Forum award for best reviewer** was granted to Dr. Antoni Meseguer-Artola (Open University of Catalonia, Barcelona, Spain).

The **Rii Forum award for best ICT-enhanced presentation** was granted to Professor Placido Pinheiro (University of Fortaleza, Fortaleza, Brazil).

The **Rii Forum award for outstanding research** was granted to Wei Wang, Yenchun Jim Wu, and Ling He (National Taiwan Normal University, Taipei, Taiwan) for their paper titled 'Impact of Linguistic Feature Related to Fraud on Pledge Results of the Crowdfunding Campaigns.'

Finally, the **Rii Forum award for the best paper** was awarded to Adil E. Rajput, Akila Sarirete, Tamer Dessouky (Effat University, Jeddah, Saudi Arabia) for their paper titled 'Using Crowdsourcing to Identify a Proxy of Socio-Economic status.'

This collection of research papers presented during the **Rii Forum 2019** features cutting-edge research centered on technology-induced processes and developments that shape sociopolitical and economic processes today. We remain grateful to the **Rii Forum Steering Committee** and the **Rii Forum Program Committee** for their commitment, sound judgment, and hard work in the process of organizing the **Rii Forum 2019**. We are equally appreciative of the work of the panel chairs who ensured that timely progression of presentations and Q&A sessions. We would like to say 'thank you' to all contributing authors for their hard work and their patience in subsequent rounds of revise and resubmit. This would not be possible, of course, without the reviewers who devoted countless hours to evaluate papers submitted to this volume. Finally, we would like to express our gratitude to the entire Springer team and the Editors of Complexity for enthusiastically embracing our idea and for guiding us through the process.

Considering the quality of research presented during the conference and the amount of networking that was triggered during the conference, we would like to take this opportunity to invite you to join the **Rii Forum 2020** which will take place in Athens, Greece, in April 15–17, 2020. Please check the **Rii Forum** Web site (https://rii-forum.org) for updates.

Warsaw, Poland
Athens, Greece

Sincerely,
Anna Visvizi
Miltiadis D. Lytras
Chairs
Rii Forum 2019

Contents

Emerging Issues: Technology and Society

The Climb to Success: A Big Data Analysis to Find Out Why Huawei Has Conquered the Market

Orlando Troisi, Mara Grimaldi, Francesca Loia and Gennaro Maione

Abstract Today's electronic devices are in common use for most people, who use them to perform a multitude of activities. Technical change and new product proliferation have made this industry extremely dynamic. The work aims to highlight the reasons why millions of consumers prefer the purchase and use of products offered by Huawei, one of the most important companies in the sector. In this regard, a Big Data-oriented approach is followed. In particular, social media analytics is applied on Twitter by taking into consideration people's opinions expressed about Huawei over a five months period. Overall, over one million tweets were selected, collected and analyzed. In particular, social media analytics are applied on Twitter by taking into consideration people's opinions expressed about Huawei over a five months period. Overall, over one million tweets were selected, collected and analyzed. Afterward the collected data were subjected to a sentiment analysis, a word cloud analysis and a cluster analysis. Results show the existence of numerous aspects able to affect the smartphone consumers' behavior. In fact, in addition to traditional factors (such as price, value for money and so on) it is surprising that many consumers choose Huawei based on additional elements, such as design, quality, and brand loyalty.

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1 Introduction

For just over a decade, the vast ecosystem of technology has undergone a radical transformation, characterized by a rapidity of innovation unprecedented in the recent history, marking the contemporary and future evolution of society in all its aspects [28, 32, 59]. This change was determined by various factors but above all by the spread of electronic devices (especially smartphones, tablets, laptops, smartwatches, etc.) able to satisfy any kind of need. Nowadays, in fact, there is no person who does not use or, at least, know what these electronic devices are and how they are made.

Today's electronic devices are in common use for most people, who use them to perform a multitude of activities. Specifically, smartphones, tablets and laptops can be employed for recreational reasons (for instance, to take pictures or record videos, connect to social networks, send instant messages to friends and relatives, listen to music, etc.), for motives related to study or work (such as to write or read documents, consult e-mails, organize or join a videoconference, etc.), to move easily (using the device as a satellite navigator), to search for a restaurant or hotel for a certain period of time, to book a trip by plane or train) and so forth [31, 29, 60].

Thus, thanks to the possibility offered by new technologies (enhanced connectivity, faster and immediate interactions, and easier purchase modalities) the pervasive use of mobile devices redefines users' lives and, consequently, their purchasing behavior. On the other hand, companies have the opportunity to monitor and collect users' feedback 24 h per day to understand their opinions and/or predict their behaviors.

Despite the significant impact of Big Data on contemporary marketing evolution, extant research does not employ big data analysis and analytics to shed light on customer decision-making processes and behaviors [16]. Literature on big data analysis and consumer behavior can be integrated to explore how the new technologies can help companies to observe consumer's attitude, intentions and behaviors.

In this scenario, the work aims to provide an empirical evidence of the main reasons of the success of a well-known company operating in the development, production and marketing of electronic products, digital systems, network, and telecommunications solutions [30, 51, 52].

In particular, the research seeks to highlight the reasons why millions of consumers prefer the purchase and use of products offered by Huawei, one of the most important companies in the sector, founded in China but present in more than 140 countries with over 180,000 employees. The scientific articles aimed at investigating the reasons for the success of Huawei are rather few and, among other things, none of them performs a quali-quantitative investigation by considering a sample with dimensions capable of allowing for an adequate generalization of the results.

In order to meet the research goals and to address the gaps identified in extant research, the work follows a qualitative-quantitative approach, based on a big data analysis, carried out with regard to the people's opinions expressed on a specific digital platform (social network) in a chosen period.

The work is structured in 6 sections. It opens with the analysis of the theoretical background, reporting the scientific evidence emerging from the literature on big data analysis and on its role in understanding electronic devices' consumer behavior, focusing on the contributions dedicated to the company "Huawei". Subsequently, the research design used to collect and analyze data is described; later, through the use of a series of tables and graphs, the results arisen from the analysis are summarized; after that, the findings obtained are discussed to offer a plausible interpretation of their meaning; following, the potential implications of the work are highlighted, both from a theoretical-scientific and a practical-managerial point of view. Finally, within the conclusions, the limits of the work are underlined and some suggestions for possible future research are offered.

2 Theoretical Background

2.1 Smartphone Industry and Consumer Behavior

Smartphones, i.e. mobile phones with advanced computing capabilities and connectivity than the regular ones, came into the consumer market in the late 90s, gaining a mainstream popularity with the introduction of Apple's iPhone in 2007. Starting from the launching of the first iPhone, Apple definitely defined a new category of product, accelerating the convergence of traditional mobile telephony, Internet services and personal computing into a new industry. In this regard, Park and Chen [43] show that the behavioral intention to use the smartphone was largely influenced by perceived usefulness and ease of use toward using it. Today, becoming the standard configuration among different types of mobile devices, the mobile phone industry represents a very innovative segment within the ICTs sector. Technical change and new product proliferation made (and keep on making) this industry extremely dynamic, even if market shares are highly concentrated in the hands of few companies.

Recent trends in the smartphone industry expanded previous conceptions of the industry and its boundaries. For instance, the increasing importance of Internet and cloud-based services that in many ways lie outside the control of the physical device, operating system, and even the cellular network, seems to be changing the roles and strategies of key firms in the ecosystem [45]. However, smartphone sellers shipped 355.6 million units worldwide during the third quarter of 2018, how depicted in Fig. 1, resulting in a 5.9% decline when compared to the 377.8 million units shipped in the third quarter of 2017. The drop marks the fourth consecutive quarter of year-over-year declines for the global smartphone market.

This result, as The Economist writes (https://www.economist.com), shows the market saturation and the need of specific marketing strategies to attract consumers. In this mean, successful innovation lies not in bowing down to consumer resistance, but in understanding the causes and developing a marketing strategy to attack them [46]. Indeed, since the smartphone market has reached a saturation state, device

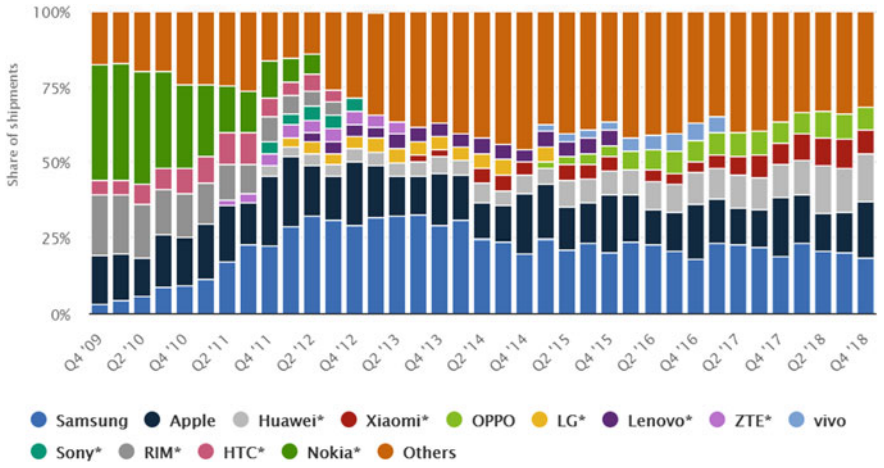

Fig. 1 Global smartphone vendors from 4th quarter 2009 to 4th quarter 2018. *Source* https://www.statista.com

manufacturing companies have to re-focus their resources and capabilities to enhance customer loyalty in order to retain existing customers and attract new ones.

That said, there are only few studies on customer loyalty of smartphones. Kim et al. [22] analyze the Korean smartphone market, showing that customer satisfaction and switching barriers (alternative attractiveness and switching cost) have significant impacts on customer loyalty. The device features (functions, usability and design) and corporate factors (customer support and corporate image) significantly influence customer satisfaction. Usage characteristics (relationship length and usage experience) moderate some of the links in the research model. According to a report by IDC (https://www.idc.com), the world's five biggest smartphone companies are Samsung, Huawei, Apple, Xiaomi, and Oppo. Samsung remains the leader, while the Chinese smartphone maker, Huawei, has surpassed Apple. Huawei, consequently, by maintaining its second position based on global market share, surpassed Apple for the second consecutive quarter as well as continues to lead the China smartphone market with 13.4% YoY growth in Q3 2018. Also, Huawei's P20/P20 Pro series found strong demand in the US$600 < $800 price segment, helping Huawei build a high profile in the global market while its extended distribution network remained the driver to push its presence in the domestic market.

This complex and dynamic scenario makes central the role of the consumers and their purchasing behavior, as today they are increasingly selective in product choice. Simultaneously, product life cycles are shortening, competition is intensifying and the new product failure rate is growing. Understanding the consumer buying process, indeed, can make the difference between success and failure in smartphone industries.

The new technologies and the subsequent innovative features of "digitalized" products introduce a revolution in contemporary markets that leads to new ways of understanding consumer behavior and formulating marketing strategy.

To understand new attitude, trends or gaps in services [16], a strategic approach to the use of new technologies and big data is needed to enhance customers' satisfaction and loyalty thanks to the continuous collection of their evaluation, complaints and feedback on products, services and brands.

Big Data consumer analytics allow the extraction of hidden insight about consumer behavior and the exploitation of that insight through advantageous interpretation. For this reason, Big Data permit to exploit the possibilities offered from new technologies to gain insights about consumer's behaviors and translate those insights into market advantage.

2.2 Big Data: A Scientometric Approach

In order to identify the scientific profile (authors, contributions, topics most frequently treated and relationships between them) of the studies carried out in the period 1990-today by Business, Management and Accounting (BMA) on the theme of Big Data, we followed a scientometric approach and, in this context, the methodologies of bibliographic mapping and clustering. It was used VosViewer (Visualization of Similarities) by Van Eck and Waltman [57, 58] software developed with the specific goal to construct, display and make publicly available bibliometric maps. It provides distance-based maps, or graphical representations, in which the importance of a term is represented by its size on the map and the distance between two terms reflects the strength of the relationships between them: the smaller the distance, the more intense the relationship binds them.

The question was addressed to Scopus, the largest database of citations and abstracts of peer-reviewed literature. Concretely, Scopus returned 2242 references.

Subsequently, through VosViewer, a bibliometric map relative to the bibliographic coupling of the census references was created. VosViewer highlighted 1106 linked contributions, grouped into four different clusters, as shown in Fig. 2.

The first cluster (the green one) is focused on "Data Mining techniques for Big Data". Big Data has becoming increasingly central, generating a new era in data exploration and utilization [8]. The "mass digitization" [14] led to a rapid expansion of large amounts of data, characterized by large-volume, complexity, multiple and autonomous sources. This phenomenon is continuously evolving, as reported by the "3Vs" model of Laney, which highlights the increasing of the volume, velocity and variety of generated data [3, 67, 68]. Later, other concepts as veracity and value have been attributed to this model, with the aim to highlight respectively the quality across datasets and the capacity to generate useful output for industry challenges and issues [56]. In this scope, the Data mining techniques permit extracting useful information from large datasets or streams of data [17] and can reveal insights, supporting decision making. Indeed, from the data mining perspective, the data-driven model involves demand-driven aggregation of information sources, mining and analysis, user interest modeling, and security and privacy considerations [44, 63].

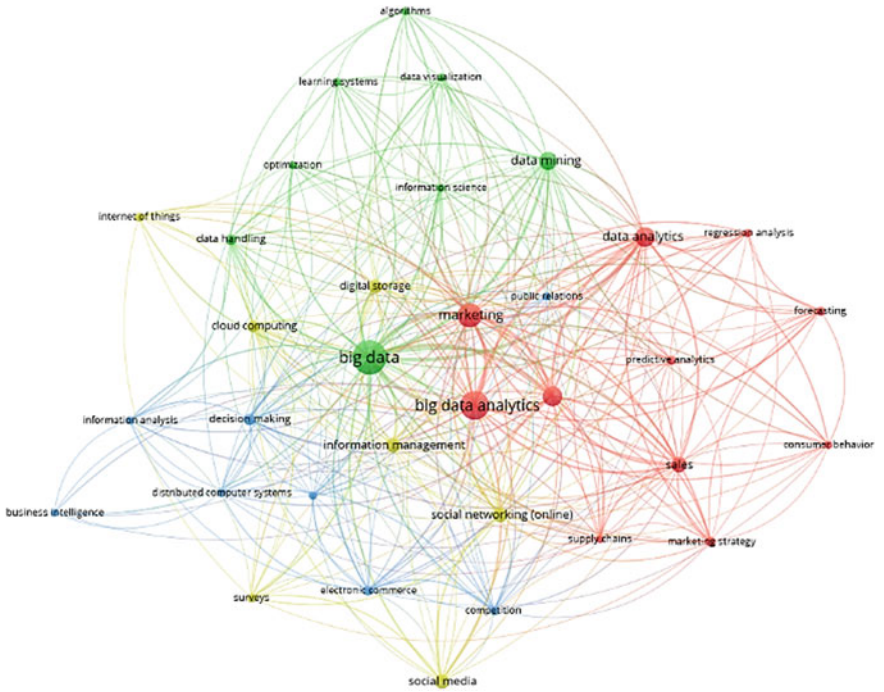

Fig. 2 Big data network visualization in business, management and accounting field. *Source* Authors' elaboration

The second cluster (the red one) regards "Big Data Analytics for Marketing". Undoubtedly, consumer analytics is at the epicenter of a Big Data revolution. New analysis techniques helps capture rich and plentiful data on consumer phenomena in real time, enabling the process of collecting, storing, extracting and utilizing consumer insight to enhance companies' dynamic and adaptive capabilities [16]. Therefore, marketing practice is always more influenced by data culture, by relying on the processes of data mining and A/B testing rather than human intuition [20]. The aim is to carry out consumer behavior analytics offering a look inside the "black box" of markets by providing meaningful information able to support the decision-making process and to improve of various business services to significantly improve customer experience as well as value creation for organizations [2].

The third cluster (the yellow) is about the "Big Data generation". The social networking phenomenon permit to create, modify, share, and discuss Internet content in a very dynamic way [1, 13]. Thanks to user-generated content, such as text posts or comments, digital photos or videos, and data generated through all online interactions, the online social networks grow by connecting a user's profile with those of other individuals or groups [39]. Therefore, social networking Web sites are amassing vast quantities of data and computational social science is providing tools to process this data. Especially, with announcements of growing data aggregation by

both Google and Facebook, the need for consideration of these issues is becoming urgent [40]. Indeed, leveraging the social network paradigm could enable a level of collaboration to help solve big data processing challenges [49]. On the other hand, also the phenomenon of Internet of Things (IoT), relying on physical objects interconnected between each other, creates a mesh of devices producing large quantities of information. The sensors are surrounding our environment (e.g., cars, buildings and smartphones) and continuously collect data about our living environment [6]. Over the last few years, all such solutions capture large amounts of data pertaining to the environment as well as their users. The IoT's goal is to learn more and better serve system users.

The fourth cluster (the blue one) is about the "Decision-making and Business Intelligence in Big Data era". Therefore, decisions will increasingly be based on data and analysis rather than on experience and intuition [33]. Organizations are looking for ways to harness the power of big data to improve their decision making, taking advantage through an evolutionary process in which the gradually understanding of the potential of big data and the routinization of processes plays a crucial role [21]. Indeed, with exponential growth in data, enterprises must act to make the most of the vast data landscape, by applying multiple technologies, carefully selecting key data for specific investigations, and innovatively tailor large integrated datasets to support specific queries and analyses. All these actions will flow from a data value chain a framework to manage data holistically from capture to decision making and to support a variety of stakeholders and their technologies [34]. Connected to the impact of data-approach in contemporary business organizations is the Business Intelligence field [8]. Numerous companies already foresee the enormous business effects that analytical scenarios based on big data can have, and the impacts that it will hence have on advertising, commerce, and business intelligence [61].

3 Research Design

To achieve the research goal the work follows a both qualitative and quantitative approach, based on big data analysis, realized taking into consideration people's opinions expressed on a specific digital virtual platform (social network) in a chosen time span. In detail, the "social search" was used. It is based on the mining and analysis of online data [5] to provide summary information, preliminary to reliable considerations about the investigated phenomenon [11]. The social search is increasingly used for research purposes since it offers numerous advantages, especially in terms of the number of metrics that can be generated, identification of the most frequently used key words (hashtags), anticipation of future trends, reports drafting, minimization of business risks, analysis of attitudes, deduction of the Key Performance Indicators (KPIs) in corporate decision-making, better targeting of marketing strategies, analysis of time series, optimization of resources, identification of solutions to complex problems and so forth [36].

Data collection started at the beginning of September of last year and was completed at the end of January of the current year. The virtual environment used for data collection is Twitter, one of the most popular social networks (third after Facebook and YouTube) with over 330 million active users [52]. Among the various possible alternatives, the choice fell on Twitter to exploit the "rule" imposed by the developers of the platform, which allows each user to write posts containing no more than 280 characters. This aspect has made possible to streamline data collection.

Figure 3 represents a screenshot of the Twitter page, made during the search for posts containing the hashtag #Huawei.

At the end of the collection phase, the data were analyzed to be appropriately interpreted. Specifically, the users' posts were taken into account to obtain sufficiently reliable information about the reasons why more and more people prefer Huawei products, contributing to its success all over the world. To avoid conceptual distortions, the extracted text was "cleaned" through a procedure that eliminated all stopwords. Moreover, to facilitate the understanding of the results, a wordcloud was represented in Fig. 4, with terms of different size and color depending on the frequency with which the users used them.

Furthermore, a sentiment analysis was carried out to understand the polarity (positive, neutral or negative) of the comments, i.e. to know how much the users' opinion expressed through their tweets was favorable with respect to Huawei products.

Fig. 3 Screenshot of data searching. *Source* Authors' elaboration

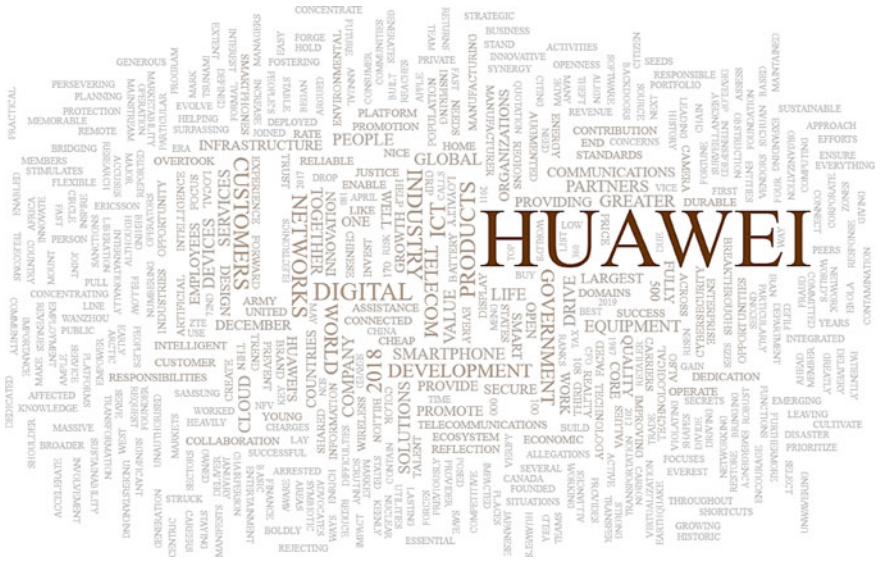

Fig. 4 Wordcloud

This analysis is performed usually to extract information from online sources and texts (reviews, comments, posts, etc.) through the determination of positive, negative or neutral polarity. The most common approaches can be sub-divided into three macro-categories: keyword detection, lexical affinity and statistical methods. Keywords detection allows the classification of the text into some recognisable emotional categories, identified based on the presence of unambiguous emotional words (e.g. happy, sad, and bored). The method of lexical affinity, after the detection of the emotional keywords, assigns arbitrary words to particular emotions based on their semantic affinity.

After mining, the gathered data were subjected to a sentiment analysis to enable the identification of people's perceptions about Huawei's products, allowing understanding the overall polarity of the extracted words: the most frequently found words were submit- ted to the sentiment check against a lexicon annotated with sentiment values in order to establish their potential positive, negative or neutral value. The check returned values in the [0–1] range, which represents the words' positivity, negativity or neutrality, whose total sum is 1.

Next, a cluster analysis was performed to identify the main "group of elements" considered by Huawei's consumers. Introduced by Tryon [54], it is based on the use of multivariate analysis techniques aimed at the selection and grouping of homogeneous elements in a dataset. Clustering techniques are based on measures related to the similarity between the elements, expressed in terms of distance in a multidimensional space. The clustering algorithms group the elements by considering their mutual distance, which indicates the belonging to a certain set (cluster). To this end, the hierarchical method was chosen for the analysis, by virtue of the fact that it allows

building a hierarchy of partitions characterized by a decreasing number of groups, viewable through a tree representation (dendrogram), in which it is highlighted the division of identified groups. Precisely, the cluster analysis was carried out by using an agglomerative hierarchical algorithm, which assumes that, initially, each cluster contains a single point and, at each step, the "closest" clusters are from time to time merged to obtain a single larger cluster.

All the procedures were defined based on semi-automated procedures, defined and operationalized with R, an open source statistical environment based on a programming language and a specific development environment for the statistical analysis of data.

4 Findings and Discussion

The analysis provided useful information about the main features of Huawei products that can orient users' attitude. In particular, the results highlight the existence of multiple factors, grouped in five clusters (Fig. 5), capable of inducing users of electronic devices to prefer Huawei.

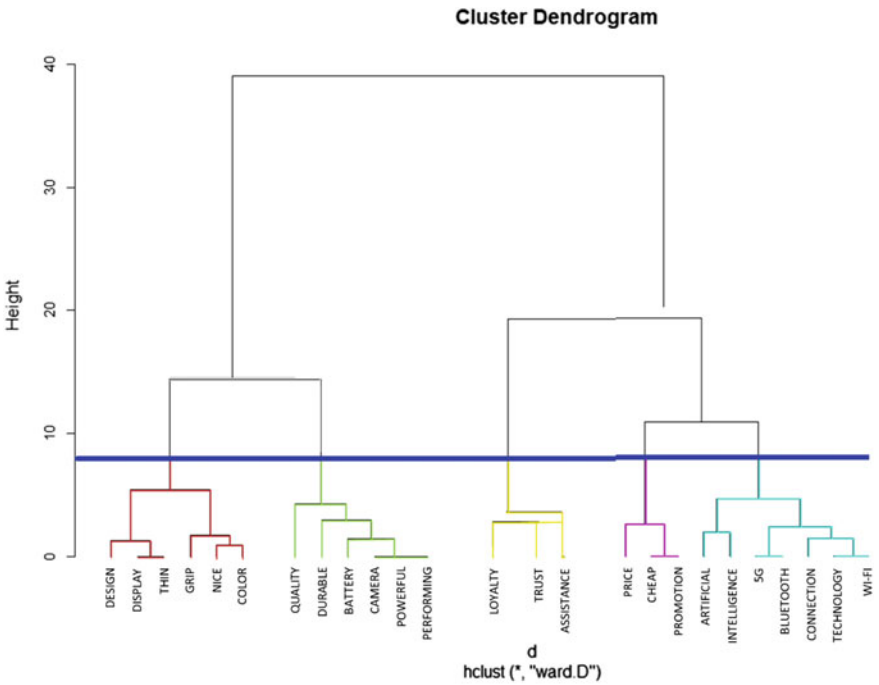

Fig. 5 Cluster analysis

First, from the analysis carried out emerges that the cluster "Design" figures at the first place. Factors as "display", "thin", "grip", "nice" and "color" belong to this group, indicating the consumer attitude to focalize on aesthetic aspects. According to Nanda et al. [38], the aesthetic design of a smartphone has an impact on emotional reaction of people, showing that smartphone is always more perceived as a fashion accessory, as well as a communicating tool. Therefore, consumer's switching behavior from incumbent smartphone to new one can be explained by not merely rational assessment but also affective aspects like aesthetic or pleasure and emotional points like attachment. Consumer's attachment to aesthetic would influence rational evaluation to switch or not to other brands, becoming an important research topic [26]. Another study [50] highlights how aesthetics' primary effect on purchase intention is not direct but rather indirect through perceived sociality and to a lesser extent, perceived emotional value while the importance of aesthetics on perceived functional value is far less. Therefore, these aspects highlights how aesthetics and product design can be used to strengthen purchase intention and influence consumer behavior in terms of both product development and promotional strategies. In this direction, aesthetics' appeal to social and emotional perceived values provides ideas on how to exploit aesthetics in promotional campaigns. Huawei, in particular, starting from the C7100 mobile phone, aimed at the Chinese market, sold more than a third of a million in the three months after its launch in 2008. After, the company carried out the strategy of elaborating technology connected to the European demand for simple aesthetic design. The result was a distinctive design language that is central to Huawei's international strategy. The company now has one of the largest in-house design teams in the world with design centers in the UK, Japan and the United States (https://tangerine.net). Then, Huawei opened its first global research center focused on innovation in aesthetics and design, part of the $600 million investment plan in France (https://huawei.eu). During the 2018, Huawei has announced that the Huawei P20 Pro has become its best-selling high-end device in Western Europe, with a growth of over 300% on an annual basis. Huawei P20 Pro, characterized by particular design, was announced last March 27 in Paris and has been put on the market. In the four weeks that followed, twitter related to aesthetic factors grew and sales rose by 316% compared to last year with P10 Plus (https://huawei.hdblog.it). In addition, Huawei's launched an accompanying Porsche Design Huawei Mate RS, which is a fancied-up P20 Pro. The aim is to offer in the luxury mobile segment a device with great technical performance, as the Chinese house promises, but with the distinctive touch of design of a brand rooted in a European imaginary.

In the second place, "Quality" is ranked. Aspects as "durable", "battery" and "camera" represent the perceived quality of smartphone by consumers. Indeed, according to Parasuraman and Grewal [42], Tsiotsou [55], perceived product quality is expected to influence consumer repurchase intention. Chen and Ann [7] highlights that the attribute of 'battery duration' is very important for customers but offers relatively lower satisfaction, which should be improved as a top priority for the smartphone companies. The longer battery duration has been a common expectation for the smartphone addicts, and smartphone manufacturers need to focus on this aspect. In the future, it is probably that the battery duration will be longer than one day so that

people will no longer need to carry around an extra battery charger for normal use. Filieri and Lin [19] shows that the consumers that have already purchased, and then experienced, a smartphone brand can judge its level of quality in terms of its durability, functionality, reliability, and performance. Based on previous usage experience, if smartphone brand is perceived to be of high quality, consumers will repurchase it, otherwise they may switch to another brand. Therefore, a smartphone brand that is considered as durable, functional, reliable and robust will also influence consumers' repurchase intentions. This result can be explained by the fact that in the current society smartphones are used daily to perform multiple and important tasks, requiring an excellent quality to enable individuals to do efficiently and effectively what they want. Presented to the western consumer as a Chinese economic sub-brand, today Huawei earned respect and admiration by consumers. Indeed, the opinions of users on Huawei are mostly positive. In particular, Huawei Consumer Business Group (CBG) South Africa strives on becoming the first brand for consumers in the country after finishing 2nd in the South African Customer Satisfaction Index (SAcsi) report, conducted by Consulta, on mobile phones. Now in its fifth year, the SAcsi for Mobile Handsets offers impartial insights into the South African mobile handset industry by measuring the customer's overall satisfaction. This satisfaction score is based on brands exceeding or falling short of customer expectations and the respondents' idea of the ideal product to achieve an overall result out of 100. The measurement also includes, among other measures, Customer Expectations Index, Perceived Quality Index and a Perceived Value Index (https://mybroadband.co). In addition, thanks to the collaboration with Leica, a famed photography brand known for some of the most iconic portraits and street photography images, Huawei transfers that picture quality to a smartphone, conquering consumers regarding the camera potentialities (https://www.stuff.tv).

The third position is occupied by "Price". "Promotion", "rate" and "cheap" belong to this group, highlighting the importance of the convenient purchase for consumers. Price concern is one of the determinants tested to find out the effects on demand of Smartphone [10]. In addition, a research found that price significantly impact on the purchase intention of Smartphone among young adults in UTAR, Perak, Malaysia [9]. Therefore, the smartphone customer is often influenced by the product quality and its price as well [15]. In terms of pricing strategies, each company follows a particular path. Apple did not follow a wave of low-price handsets strategies, introducing new high level smartphones to create more profit and providing lower selling prices for the old smartphone models. Apple iPhones are more expensive than the others and the decline in their price points are very limited. Still, when Samsung and HTC released high-level smartphones into the market, their price levels fall quite quickly after a few months. Nevertheless, the sales volume of Samsung Galaxy is not as expected possibly due to market saturation of high-level handsets and the fierce competition of low-level handsets coming from China [7]. Huawei faces tough competition from Ericson, Cisco System, ZTE corporation, Apple etc. As the numbers of competitors are more in the telecommunication industry, Huawei follows a competitive pricing strategy in its marketing mix for its products. The reason for this pricing strategy is because buyers (consumers) have more bargaining

power and can switch brands easily. Huawei always focuses on providing best quality products to its customers as pricing are nearly same by all competitors. Huawei also charges high prices for its new and innovative products that are not in the competitor's product line. Huawei sometimes follows elastic pricing policy and gives discount on its products mostly sold through ecommerce. For its business division of Enterprise and carrier products, the company charges premium pricing strategy for its innovative products and solutions (https://www.mbaskool.com).

In the fourth place "Brand Loyalty" is ranked. In this group, some factors are "assistance", "trust" and "trend", representing an attitude of loyalty from the consumer perspective towards Huawei brand. Indeed, with the growth and competition of the smartphone industry, developing a better understanding of what drives consumers' loyalty to smartphone brands has become an important issue for academics and practitioners. Yoo et al. [66] investigate the importance of positive reputation from external experience sources for diffusion of smartphones. By categorizing the different reputation sources into four group (personal, expert, consumers and mass media), the authors found that the prior experience of consumer group has the largest importance for the purchasing decision of the potential adopters. Moreover, early adopters and female consumers give more importance on the prior consumers' opinions. The reputation from expert and mass media was relatively lower than it from consumers and personal group. A study in Malaysian shows that 35.6% of the total 1814 respondents reported that the trend in community is the most influential factor for consumers to acquire smartphone instead of the actual needs [41]. In addition, another study on the factors influencing smartphone buying process [27] reveal that, together with the aesthetic value or beauty of design, the brand reputation are positively correlated with the repurchase of smartphones. In order to analyse consumer behaviour in the smartphone market in Vietnam, Wollenberg and Thuong [62] highlights that there is substantial influence of brand perception on customer choice in smartphone market. Yeh et al. [65] show that age enhances the "emotional value-brand loyalty" and "social value-brand loyalty" linkages but weakens the "brand identification-brand loyalty" relationship. Furthermore, gender does not play a moderating role in the determination of smartphone brand loyalty. However, for many years, the brand loyalty was a force for Apple, by leveraging on the ecosystem Apple (iPad, Mac, MacBook, etc.), iOS, after-sales assistance, and trend. Instead, regarding Huawei, diversifying portfolio made harder building brand loyalty, as it is difficult to build up hype around so many different devices. According a report (https://www.brandindex.com) Samsung has an Index score (which measures a range of metrics including quality, value and reputation) of 37.5, Sony follows on 24.3, ahead of Apple's iPhone on 22.7, Nokia on 16.5 and LG on 14.7. Huawei's score is just 6.4. Anyway, the brand Huawei is headed in the right direction. Indeed, its Index score is up by 5.5 points over the past year, a statistically significant increase. In particular, consideration is rising up 1.8 points to 5.2 over the past year, as the purchase intent. Therefore, Huawei should concentrate more on areas such as image building, manufacturing quality products, and ensuring customer satisfactions [23]. As regards the Chinese market, Huawei is perceived better than Apple by consumers despite their

preference for global companies (https://www.scmp.com) but this aspect does not influence the analysis considering that Chinese people generally do not use Twitter.

The last cluster is "Innovation". This group contains factors as "artificial intelligence", "5G" and "augmented reality", underlining the importance of innovative technology for smartphone consumers'. Probably, this group figures at the end of the ranking because consumers tend to be resistant to innovation. Indeed, a study [35] identified two factors that influence consumer behavioral intention to resist to innovation like smartphone: perceived risk and perceived complexity. The result indicates that both factors have significant influence on smartphone consumers. In this mean, consumer resistance as consumer intention to adopt or reject the product makes very important difference in success of innovative products. Therefore, behavioural research shows that reasons for and reasons against adopting innovations differ qualitatively, and they influence consumers' decisions in dissimilar ways. This has important implications for theorists and managers, as overcoming barriers that cause resistance to innovation calls for marketing approaches other than promoting reasons for adoption of new products and services [12]. In this regard, the choice of an appropriate branding strategy is a critical determinant of new product success. Truong et al. [53] point out that both earlier and later adopters will favor existing brands to cope with the elevated risk associated with an innovative high technology product. However, innovation image plays an important role for smartphone brands, influencing customer satisfaction [7]. Huawei is distinguished by research and development efforts, investing between $15 billion and $20 billion in Research & Development (R&D). The research involves cloud, Internet of Things (IoT) and 5G technologies, making the company one of the most innovative in the world (https://www.reuters.com). Also, Huawei is working on Augmented Reality (AR) smart glasses that could debut in the next one or two years, potentially putting it in a race against Apple, which is reportedly working on a similar product of its own (https://www.cnbc.com).

5 Theoretical and Managerial Insights

Consistently with the most recent research conducted in the field of management and of consumer behavior [4, 48, 64], the work can be considered as a useful tool for scholars and practitioners, since it offers original ideas both under a theoretical profile and from a practical point of view.

In fact, as concerns its contribution to scientific research, the article spreads awareness about the usefulness of implementing big data analysis to interpret the reasons behind people's purchasing and using choices. Indeed, from the study carried out emerges that big data analysis can bring new opportunities to modern society and challenges to data scientists, by understanding consumers' preferences regarding products and services in order to offer them relevant offers proactively [18, 25]. Consumer analytics through big data technology helps to comprehend consumer behavior, influencing various marketing activities and enabling firms to better exploit

its potentialities [16]. Therefore, big data analytics associated with database searching, mining and analysis can be seen as an innovative IT capability that can definitely improve firm performance [24]. Furthermore, the research provides empirical results able to corroborate what emerged in some recent studies dedicated to the theme of consumer behavior in smartphone field, offering the advantage of results generalizability, due to the consideration of a particularly large sample. In particular, enriching the existing literature [37, 65], this work underlines and classifies the factors capable of inducing users of electronic devices to prefer Huawei, highlighting the increasing importance of aesthetic aspect of a smartphone, by having the potential to impact the consumer emotion [47]. Instead, the analysis shows that regarding innovation the consumer tends to be resistance [35]. This has important impact for both theorists and managers, which should overcome the obstacles that cause resistance to innovation by applying different marketing approaches to the promotion and adoption of innovative products and services [12]. With reference to managerial implications, the work could be considered useful by practitioners who want to know how the smartphone market is moving, what are the variables that can be used to attract consumers, what are the assets toward which invest mostly in order to achieve the desired objectives. In particular, the document could encourage entrepreneurs and managers to reflect on factors to be taken into account to take advantage of all the needs connected to the smartphone. In this regard, the work highlights five variables, ranking them in order of occurrences, allowing those who have invested or intend to invest in smartphone sector to know which aspects to pay most attention. Indeed, in a dynamic and saturated market as smartphone sector, always more are required studies in consumer behavior. Tackling this challenge from companies is less difficult if they have a clear understanding of consumers' needs and preferences. In short, the reading of the article could represent a theoretical-empirical basis from which to understand how a company can quickly acquire and retain an increasing number of customers and conquer the market.

6 Conclusions, Limitations and Future Research

The work presents several original elements, traceable both in the research objective and in the approach followed to achieve it. In fact, previous scientific contributions do not analyze the success of Huawei through a big data analysis to provide generalizable empirical evidence.

Moreover, the exploration of users' behavior thanks to Big Data extraction can enhance the understanding of the possibilities offered from new technologies to monitor all the stages of consumer decision-making cycle, including what the consumer does, how it is done, how he can choose between similar products and how he enjoys services. In this way, academic and managerial dialogue between consumer behavior and data mining researchers can be encouraged.

However, the paper presents some limitations, related to the type of technique used to collect and analyze data. In fact, even if big data analysis offers a series

of advantages (primarily the possibility of analyzing a huge amount of data in real time), it is characterized by a certain degree of superficiality, since it does not allow going deep into the understanding of the people's opinions [11]. In fact, although the sample was particularly large, the automated collection of people's comments has prevented from going deeper in the analysis of users' complete thought. In this regard, for instance, think of the impossibility of adequately interpreting the sarcastic or ironic statements.

Therefore, the methodological limits of the work are related to general criticalities of big data (veracity, volatility) and on the impossibility to generalize findings obtained through data mining [20]. Big data collection and analysis allow the exploration of what people say without providing an analysis of the motivations underlying their opinions. Complex constructs, such as motivation and attitude can be only inferred from Big Data sources [16]. Big Data sets do not permit to store all the factors influencing consumer decisions. For instance, users can express opinions only on given features of a service and the opinions expressed by users that already enjoyed a service cannot be distinguished from those of the users that have never experienced the product.

Such weaknesses could induce to perform a further analysis about the same topic to compare the results emerged from this study with the findings that could arise by using a qualitative approach (such as in-depth interviews).

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