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Impact of Big Data and Machine Learning on Digital Transformation in Marketing: A Literature Review

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ABSTRACT This paper describes the impact of big data and machine learning (ML) on digital transformation of the marketing industry and the challenges it faces from a data and information management perspective. To do this, the study identified areas of digital transformation in marketing that have not yet been sufficiently covered by existing peer-reviewed academic research. Research papers were retrieved from five databases, namely Web of Science, Scopus, ScienceDirect, Emerald, and ProQuest. Screening of 214 articles resulted in 69 articles being selected for this literature review. A gap in the existing research was identified, with five areas directly related to digital transformation in marketing. Another five potential opportunities for future research in the area of big data utilisation and application of ML-driven technologies in the marketing field were also identified. An investigation of the prospects of digital transformation in marketing can benefit both academic researchers and business practitioners working in the domain of information technologies (IT), information systems (IS), business, and marketing, by identifying areas needing primary research, systemisation, follow-up research, validation or gathering of empirical data.

INDEX TERMS Big data, digital transformation, marketing, information management, disruptive technologies, machine learning (ML).

I. INTRODUCTION

Continuous technological advancement is forcing organisations to change their traditional operations, adjust their processes, adopt new information systems, and keep their existing systems up to date. These new technologies have the potential to disrupt consumer behaviour, management processes, and organisational strategy [1], resulting in the generation of almost endless amounts of data. Humans' ability to absorb, interpret, and base complex decisions on this data has already been outpaced [2]. Organisations are drowning in this data pool, while struggling to extract meaningful information and knowledge that are useful for decision making.

Marketing is crucial for ensuring the growth and development of any business. In fact, it is acknowledged that marketing is enhancing the potential for a business entity to safeguard its bottom-line and gain competitive advantage.

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Marketing is a dynamic and ever-changing business function. Its role has undergone dramatic changes as a result of many contributing factors and triggers, including crises/economic recessions, dying industries, rapid technological advances, inflation, as well as energy and material shortages. Effective marketing is of paramount importance to offer the right product to the right customers at the right time. To achieve this, information has to be managed in a systematic manner and meaningful information has to be extracted from generated data. It is imperative that modern day marketing executives become increasingly market and data driven. This requires formalised ways of obtaining timely and accurate information pertaining to the marketplace, products and customers, as well as the overall business environment [3].

The massive challenges and opportunities related to new technologies and increased availability of data are forcing marketing organisations (agencies, media, advertisers) to transform their business models. Digital transformation can be defined as 'the use of new digital technologies (social

media, mobile, analytics or embedded devices) to enable major business improvements, such as enhancing customer experience, streamlining operations or creating new business models' [4]. Digital transformation redefines current and future business activities, requires certain applications and infrastructure, and needs a digital financial framework, which all pose challenges for organisations [5]. Digital transformation affects the way organisations handle information and disrupts their business models. It gives companies the choice to either grow by adapting to the change or to gradually disappear [6].

New concepts and technologies, including the internet of things, big data, machine learning (ML), artificial intelligence (AI) and others, require massive adaptation from companies. There is also a need for companies to incorporate the role of chief digital officer (CDO), allowing them to have a role model to guide them and keep them up to date with the pace of the technology changes [7]. Companies also need to establish frameworks for continuous analysis of ways in which disruptive innovations/technologies might challenge or benefit them [8].

This literature review examines the impact of big data and ML on digital transformation of marketing organisations and the resulting challenges, from a data and information management perspective. The main objective of this study is to identify aspects of digital transformation of the marketing industry that have not been sufficiently covered by existing peer-reviewed academic research. By accomplishing this goal, other researchers will save valuable time when looking for areas related to digital transformation in marketing that need more attention, follow-up research, validation or gathering of new data.

The main objective was supported by providing answers and solutions to these two supportive goals:

- 1) Identify challenges of digital transformation of organisations in the marketing industry, from a data and information perspective.
- 2) Provide insights into the implications of big data and machine learning on digital transformation in marketing.

This study forms part of a larger research project focusing on reviewing the impact of major disruptive technologies on organisations in the marketing industry and marketing as a business function within organisations operating in other industries. The paper is structured as follows: Section 2 identifies issues that have already been researched, thus helping researchers, marketing organisations, marketing agencies, and CDOs to search for, and access, the most recent high-quality research on this topic. The section depicts the current state of research on the challenges facing the marketing industry in the digital era, big data as the trigger for undergoing digital transformation, and a data and information perspective on digital transformation. Section 3 provides details about the methodology of this study. In section 4, the research gap is identified, allowing researchers to grasp the opportunities for

new research projects. Section 5 presents conclusions of this study and in section 6 a final list of references is provided.

II. STATE OF THE ART

A. TECHNOLOGIES DRIVING DIGITAL TRANSFORMATION IN MARKETING

Over the past decades, the marketing field has transformed through a resource-conscious view and an investment-orientated approach to become an integral part of organisations [9]. Nowadays, marketing is networked via social media-based web, where customer engagement is key for sustained profits [9]. Marketing is, similar to other industries, becoming more digital. With digital transformation in place, a plethora of digital marketing techniques are available, aimed at providing value to customers [10]. Customer retention is higher due to these digital technologies. Particularly, their use in social media has proven successful by businesses that failed with traditional marketing methods [11]. Digital disruption has shaken the marketing industry, thereby forcing organisations to revise their operating model [12]. As a result of disruptive technologies, the traditional marketing governance funnel will not work, as there is a huge gap between businesses and customers. Using the latest technologies can increase the value of marketing and deliver more engaging experiences for tomorrow's consumers. virtual reality (VR) and augmented reality (AR) together with other sensory enabling marketing techniques are amongst the latest technologies that are impacting consumer behaviour and buying habits [13]. Today's marketing governance model is more interactive as it allows and builds upon interaction with customers [14].

The following triggers are relevant for today's integrative approach to marketing: i) Changes in media usage patterns; ii) Focus on marketing efficiency and effectiveness; iii) Firm value generated by engaging stakeholders of the firm [9]. Marketing organisations are facing demographically diverse populations where customisation, experience, convenience, and social connections matter the most, while customer expectations and needs are simultaneously increasing [15]. Technology has played a crucial part in the transformation. Digital transformation is affecting every aspect of our lives, not only through businesses leveraging new technology, but also their customers, individuals, and society itself [16]. To create value in more efficient and effective ways by using the latest technology, marketing organisations must disrupt themselves [16]. It is not enough to conduct digital optimisation of business processes; businesses need to disrupt their vision together with technology [17]. Technology has emerged as an integrator of markets where geographical limitations are ever more blurred [15], offering deeper insights offered by data availability [9]. Powerful connectivity is vital for global presence and communication [18]. Todays' digital environment captures more data than ever before and organisations are using this data for marketing analytics to shape their business strategies [19].

B. DATA-DRIVEN ORGANISATIONS

Big data, while providing several attractive opportunities for business, also presents challenges to the marketing industry [20]. The volume of data is expanding rapidly with many data types (structured, untrusted and semi-structured) and data sources available [21]. This high volume, fast-moving data is not matched with the traditional database structures. It also creates challenges such as privacy, management, security, and ethical issues in terms of monitoring and gathering private data of customers, which should be addressed through information governance to gain the real value of big data [22]. Marketing organisations must develop effective data governance structure to improve data quality, security, accuracy, meaningfulness, value, etc. by minimising those challenges and risk as a foundation of the information management structure of the organisation [21]. Data is considered an important asset and if the organisation fails to implement and maintain an effective governance structure, it will face huge losses in its value of the data [20]. Just having huge volume of data does not provide value or knowledge to the organisation [22]. Organisation must implement an effective data governance structure to transform that raw data into knowledge obtain the competitive advantage of big data.

New technologies empower organisations to collect more valid information and data from outside. The key is to guide people to interact with this information [23]. Technology has changed everything, and it allows for new ways to create customer experiences, new mediums to connect with customers and other constituents, and trillions of data points to understand customer behaviour and the impact of marketing programs and activities [14]. However, as they further note, technology is just the first step. To fully realise the potential of technology, it takes transformation across people, processes, and technology [14].

By adopting big data, organisations can transform themselves into data-driven organisations, enabling them to innovate their marketing programs by collecting large amounts of data both structured and unstructured [24]. From the technological perspective, organisations can manage and organise big data properly with increasing their storage capacity, using new NoSQL as an alternative traditional database [24]. Big data assists in extracting individual personalisation from a large amount of collected data [25]. She further notes that the growth of big data has introduced a wealth of opportunities for researchers, including new sources of data produced by the media industry, massively larger amounts of information, and a spectrum of analytical software applications [25]. Possessing big data does not necessarily lead to improved marketing. However, the potential is huge as big data can be regarded as raw materials, secret treasure, and vital assets of the firm [26]. Big data enhances an organisation's productivity by improving business operations and increasing the efficiency of the industry by better pricing, improving feedback from customers, providing cost reductions, etc. [24].

To take advantage of big data, marketing science will need to embrace disciplines such as data science, machine learning, text-processing, audio-processing, and video-processing [27]. Analytical marketing tools utilising ML can assist with extracting meaningful information from large amounts of data [28].

C. EXTRACTING INFORMATION AND KNOWLEDGE FROM DATA

Consumers are spending more time using online media instead of traditional media [29]. The quantity of data that is generated requires a change in the standard analysis procedures. These procedures now have to include cloud computing, text mining, and machine learning, also usable for forecasting [30]. The necessity is even more apparent as most of data generated in marketing is unstructured [31]. Unstructured data is also regarded as a challenge by [32] who mentions the availability of continual information about an average consumer in a form of transactional data and unstructured, behavioural data [32]. Hence, big data massively disrupting the traditional ways to make marketing decisions [33] and simultaneously deepens the understanding of consumer behaviour [34].

Big data is normally associated with the three Vs: volume, velocity, and variety. Furthermore, two additional Vs are added to emphasise the importance of collecting, analysing and extracting meaningful knowledge: veracity and value [32]. Because of the big data predictions, real-time responses can be embedded into marketing strategies [34]. The challenge for organisations is to use data for gaining sustainable competitive advantage as currently there is too much data and too little knowledge how to use it efficiently to gain benefits. Thus, it becomes clear that organisations must develop new capabilities and resources to exploit big data as it is affecting every area of marketing [32]. Researchers agree that more research is needed to find novel ways to survive the big data revolution [32] and learn the best practices to extract knowledge from unstructured data [34]. Automatic classification of large-scale datasets significantly contributes to deriving business value [35].

Big data and analytics are very useful to determine the values and needs of customers to develop a successful omnichannel marketing strategy [36]. In big data, information is flowing across products, channels, customers, time and location. Therefore, buyers are showing an inclination to enjoy 'research shopping', for example, accessing information from one channel while buying from another [37]. This helps with the collection of data from different channels and multiple touchpoints. Technology innovation allows organisations to track customer's online touchpoints, which makes predicting future customer behaviour possible [38]. Big data analytic tools are used to remove the redundancies. Before the data is used it goes through processes such as Extract, Load, Transform (ELT) and Extract, Transform, Load (ETL) tools [39]. These tools concentrate the data from outside sources, change the data to fit operational needs and load the data

into the database. In this manner, the information is cleaned, recorded and transformed before being made available for online analyses and data mining [39].

D. APPLICATIONS OF BIG DATA ANALYTICS AND ML IN MARKETING

1) SOCIAL MEDIA ANALYSIS

To make qualified decisions, marketers and marketing analysts still require the same information on many different aspects such as customers and their needs, competition, products, distribution channels, service providers, laws etc. However, through mobile marketing and social media platforms, the knowledge is expanded by adding detailed personal information like geo-location, time, interests, sex etc. [40]. The nature and origin of marketing data has changed as the result of digitalisation and adoption of new technologies. Marketing analysis data have shifted from panel data, where consumers manually recorded their buying behaviours, to big data, offering real-time information [34]. Similarly, the data that was previously collected through channels such as customer satisfaction surveys can now be automatically mined through social media platforms [33]. Consumers leave continuous traces in social media that can be analysed deeper by using text mining, user profiling and localisation, sentiment analysis, social sensing etc. [41], [42] claim that the question is no longer whether consumers are willing to share their private data, but how they react when their private data is widely accessible to marketers.

Using ML in sentiment analysis on social media for security purposes was researched [43]. The paper claims that sentiment analysis plays a pivotal role in social media security and analysis and has been used very effectively for analysing social media content, identifying various security aspects and providing effective solutions [43]. Their work specifically discusses the results of different ML techniques based on the performance metrics that have been used for the implementation of sentiment analysis in the respective security domains. They also identify recent studies that applied ML to various social media datasets, mainly Twitter messages, product reviews, hotel reviews, restaurant reviews. ML is used to detect deceptive reviews or spam (13 studies), identify opinion spammers (7 studies), detect bots (6 studies), and identify anomalies (8 studies). In this literature review, we will not analyse all the articles because most of them are more useful for IT & security specialists than marketing managers. Some of the articles can be tailored to increase the efficacy of advertising, as they provide more insights into the customer profiling and sentiment [43].

The issues of branding on social media and ML were central to this work [11]. The authors develop a collaborative approach between media studies and computer science to examine the emergence of algorithmic brand cultures using the case of a music festival [11]. ML also has many other applications of big data generated on social media, for example gender and sex detection [44]. These applications help

marketers to target their customers more effectively. The relationship between social tagging in online content and brand performance has been analysed by [45]. This study, for example, introduces a fully automated method to monitor brand-related messages on Twitter [46].

2) PRODUCT AND PURCHASING DECISION-MAKING

Big data also plays a crucial role in new product launches, which require large amounts of information from customers. For examples, some brands in the fashion industry draw inspiration from, and predominantly make their decisions regarding new product launches mostly based on the analysis of top trending posts on social media, e.g. Instagram [47]. Visualisation of market structures among products has also been researched. Innovative mapping methods to help visualise complex market structures among more than 1,000 products were developed, using big search data from a product- and price-comparison websites to derive consideration sets of consumers that reflect competition between products [48]. Big data and fuzzy support vector machines are used in the study by [49] to suggest a new method of understanding consumers' preferences for new complex products (e.g. digital cameras, computer tablets, etc.).

Video is another medium that generates huge amounts of data. Real-time in-store video data is processed to make recommendations for new garment purchases [50]. The comprehensive literature review identified a research gap in the application of ML and AI in the fashion and apparel industry [51]. Combining state-of-the-art computer vision techniques with marketing models of consumer preferences, the system automatically identifies shoppers' preferences based on their reactions and it uses that information to make meaningful personalised recommendations [50].

By using big data and data analytics, marketers can target customers accurately, offer personalised solutions, reach customers easily and gain competitive advantage [32]. An accurate prediction of what a customer will purchase next is of paramount importance to successful online retail and marketing [52]. Big data and its analysis with the use of two classes of models - Latent Dirichlet Allocation (LDA), and mixtures of Dirichlet-Multinomials (MDM) – are used in the prediction. LDA that is normally used in text processing to identify “buckets of words” is used here to identify sets of products that tend to be purchased together, from the consumer's perspective [52]. More research in the area of demand/purchase predictions was done [53]. The authors developed a dynamic and data-driven framework for prediction of customer's future purchase in a certain timeframe. Using a ML-driven approach and an Amazon dataset, a model was developed, assisting in accurate prediction of demand for remanufactured products in real-world e-marketplaces [54].

Extracting reusable knowledge that is understandable by machines from big data, generated by tourism surveys to create an intelligent information system for tourist destination marketing, was the task of authors of this study [55]. They used neural networks with artificial intelligence to create

a marketing decision support system that can assist users who are not experts in analysis to solve typical destination marketing problems.

3) ADVERTISING

Data, if collected strategically through the combined efforts of big data analytics and market analyses from experts, result in knowledge that can be effectively used for more targeted marketing and advertising [56]. Big data can be used to recommend content to TV audiences and help build personas of audiences [57]. Real-time feedback data also makes TV advertisements targeting more precise, predicts the viewership of a TV program, and the buying behaviour of audiences. New methods were developed that separate the target selection component and the campaign effect of online display ads, by analysing big data from two campaigns with 20 million users each [58]. Big data can be used for creative decision making [59]. Marketing needs to embrace text, audio, and video data and process them with the assistance of ML, assisting with sales predictions based on the combination of ML and big data [27]. Information technologies such as big data, AI and data analytics are used to provide the rational customer experience and service system over the both offline and online domains [60]. ML and AI is used in the field of interactive ad placement and targeting ads to the video content and to build interactive ads [47].

4) OTHER APPLICATIONS

Other applications of big data and ML in marketing include the implications of social tagging in online content on brand performance [45], the use of the ML methodology to process data from medical devices such as EEG to enhance the understanding of state of the art of neuromarketing [61] or the impact of big data analytics on the agility and preparedness of supply chains [62]. Other application areas include pricing strategy and policies, customer service (e.g. chatbots) or logistics [47]. Many of these applications have been developed, practically implemented and documented, albeit without an extensive coverage and verification in academic research.

E. CHALLENGES IN DATA MANAGEMENT AND DATA GOVERNANCE

The availability of big data in marketing and the wealth of information distracted peoples' attention and thus, efficient information management becomes the key to success [63]. Organisation of data is crucial to extract relevant knowledge, required to enhance business effectiveness [64]. Pointing out that it is vitally important to figure out the customer's expectations to gain competitiveness, which requires organisation quickly respond to rapid market changes [65]. Effective information management is an essential factor for improving organisation cooperation, and the growth of cooperation enables organisations to identify and understand customers' preferences [65]. The variety of data collected can be stored at low cost, thanks to many companies providing affordable

data storage services [38]. The amounts and variety of data contribute to the expanded possibility of data analysis, quality of which could be a determinant of the development of performance of companies or even the world economy [38].

Transformation to Web 3.0 result in networked data collection by many organisations, which is accessible to marketers [29]. A new ecosystem of marketing and advertising service firms is emerging, providing information processing services impacting marketing organisation spending patterns in shorter time intervals than ever seen in the history of modern marketing [29]. Massive amounts of data are collected and stored by organisations, despite its certainty of usefulness [41] and the amount of available data is continuously increasing [33]. As the world becomes more digital, metrics-driven organisations must be able to keep up with data management. At the same time, organisations are required to become more customer centric. They must be able to offer the right information in the right time through customer's preferred channel. Ideally, organisations should become more agile and respond to changing consumer needs faster than ever before [66]. Data is not falling into the right place automatically [67] thus, all collected data must be in a usable form to offer any value [40]. Data can only be valuable when it is set to offer useful knowledge to support decision-making [41]. Hence, there is a need for sound data management strategies in place to ensure that master data, operational data, and analytics are aligned with business objectives [66].

The main issue is that organisations do not know how to manage data efficiently. According IBM, 80 percent of organisations' data is unstructured [68]. Other challenges include storing and centralising the data, the need for real-time analytics, the accuracy of the insights, and the privacy issues [67]. Knowledge management is strengthening marketing and recommends that organisations follow the example set by others that have realised the importance of knowledge management in marketing [40]. Some research is available on the topics of data categorisation and management in marketing. For example, marketing mix framework is proposed, using the 5P model (product, price, promotion, place, and people) to generate marketing decisions based on big data analytics [33]. In their framework, the authors define data, methods, and application for each of these 5Ps [33]. Nevertheless, there is a need for new methods to analyse new types of data and determine the best practices to make data-driven decisions that facilitate marketing operations [19].

The use of latest technologies can increase the value of marketing and deliver more engaging experiences for tomorrow's consumers. In addition to these technologies, social media platforms are playing an important role. Consumers leave continuous traces in social media that can be deeply analysed by using text mining, user profiling and localisation, sentiment analysis, social sensing, etc. [41]. The question is no longer whether consumers are willing to share their private data but how they react when their private data is widely accessible to the marketers [42]. Thus, there is a need for policies and procedures to determine how to use data in marketing

while respecting one's privacy [42]. Applying information governance is recommended to set the rules for data and information usage. Defined by Gartner 'information governance is a collection of decision rights, processes, standards, and policies' [69]. Because of information governance organisations can guarantee compliance and improved management of information security risks. Moreover, they can manage the total information life cycle while information governance is ensuring information accuracy, accessibility, integrity, and security. Information governance is ultimately controlling the cost as poor data quality increases the operational costs [69].

III. METHODOLOGY

The literature review method was selected to identify the current state of research in the area of digital transformation of the marketing industry from a data and information perspective, specifically focusing on big data. The literature study was conducted between January 2020 and March 2020. The literature used to conduct this review was accessed through popular scientific databases such as Web of Science, Scopus, ScienceDirect, Emerald, and ProQuest. The process of identifying and selecting resources and their review is illustrated (Fig. 1).

Keyword combinations were prepared to search in above-mentioned databases. They included combinations, using the two main boolean operators (AND, OR), where applicable. Dozens of keyword combinations were defined, including search terms such as digital transformation in marketing, digital transformation of marketing, digital transformation, marketing, online marketing, big data, machine learning (ML), unstructured data, et cetera. A custom year range (from 2014 onwards) was defined to display the latest research. Results for every search were displayed and subsequently analysed. Using the initial screening of the paper title, keywords, and abstract, irrelevant papers were filtered out and relevant papers were added to the list of resources to be studied. Full versions of these papers were obtained and reviewed in detail. The papers dealing with a topic matching these research aims were added to the list of relevant resources. In step 6, additional keywords were compiled, using the lessons learnt from the study of previously selected papers and the behaviour of search engines in selected databases. Additional searches using these keywords, adding another boolean operator (NOT) and the follow up filtering and review of the identified papers, helped researchers complete the literature list.

Once all the papers in the list had been carefully reviewed to obtain a comprehensive list of peer-reviewed resources about digital transformation in marketing, the reference list of every paper was analysed, and the relevant papers were accessed and studied. This cycle of identifying references that were used in every newly added paper continued until no further references could be identified.

In total, 214 documents were selected and screened, after which 69 peer reviewed articles were included in the detailed

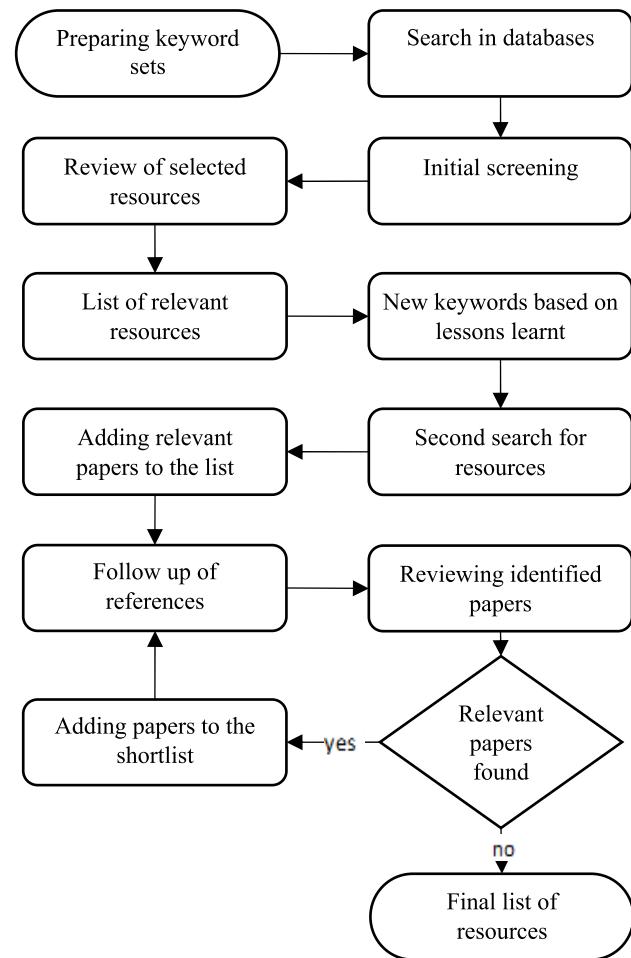


FIGURE 1. The process of compiling the comprehensive literature review.

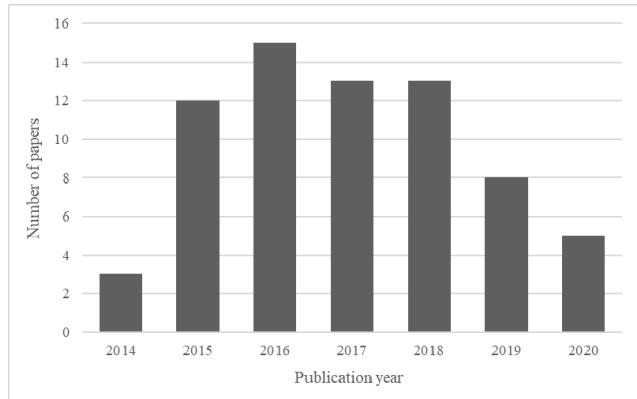


FIGURE 2. Number of papers in the literature review per publication year ($n = 69$).

literature review. These papers were published between 2014 and 2020 (Fig. 2).

IV. EVALUATION AND RESULTS

This section discusses the identified research gap indicating the issues related to digital transformation in marketing that

require further attention by academics and that represent opportunities for future research. The research gap was identified through an extensive study of relevant papers, as discussed in section 2. Apart from these papers, other studies that were not shortlisted because they do not directly relate to digital transformation in marketing, were also considered.

The first opportunity for future research in the area of digital transformation in marketing relates to i) a systematic analysis of relevant digital transformation processes, generation of process maps, creation of frameworks, and suggesting implementation models for marketing organisations. This can integrate the often-fragmented research on systems and processes of digital transformation and provide new implications for both theory and business practice.

Studying the application of the abovementioned processes, frameworks and models in marketing by organisations operating in selected industries, creates ii) the opportunity to verify them, adjust, improve, and measure the results of their application, based on defined KPIs. This information can provide other researchers and businesses with valuable insights into the implementation, challenges and best practices across industries.

Regarding the data and information perspective of digital transformation, the opportunity lies in iii) the systematic identification of information systems that can be used to deal with big data within all major marketing functions, including 4P, 7P, 7C et cetera.

The literature review has also revealed the necessity to iv) create a process for identifying and adopting selected systems for specific marketing operations, based on the requirements of organisations, their SWOT analysis, functions, et cetera.

In the area of digital transformation in marketing, both theory and business practice would benefit from generating v) an overview of best practices for innovative marketing agencies, related to the application of ML-driven analytical tools and their integration into the internal management and service delivery to their clients. Many other research opportunities exist in the areas of application of ML driven tools in marketing. For example, chatbots are being developed and launched to assist customer service and interact with the customer on social media. Virtual assistants and AI based chatbots are also deployed in other fields, including Education. The research indicated that the use of chatbots in marketing requires further academic investigation.

In the field of big data that is generated on social media and the application of ML to make sense of the data to support informed marketing decisions, existing research mostly focuses on platforms other than Twitter (where the majority of ML-related research has been done) or Facebook. For example, Instagram has been investigated in some studies. These studies were mainly non-academic, which presents an opportunity for more systematic and thorough academic research.

Apart from our focus on big data and machine learning, there are opportunities to do detailed research about other emerging technologies that have a huge impact on marketing

and that represent both challenges and opportunities for companies, marketing managers, and agencies. These technologies include AR, VR, blockchain and IoT. Academic studies into their application in the marketing field will enrich the existing literature.

A handful of pioneer papers with a focus on the utilisation of these technologies in marketing already exist in the citation databases that were included in this study. Creating a systematic overview of their scope and identifying the research gap relevant to these technologies will enable other researchers to navigate this space and position their research to fit the needs of both academics and practitioners.

V. CONCLUSION

The review of literature suggests that the exponential growth of available, mostly unstructured, data is causing information overflow in marketing organisations. Businesses must digitally transform by revising their vision and business strategies. Big data offers huge potential for marketing organisations, but to gain the real value systematic information management, analytical tools and processes need to be applied to deliver the right information to the right person at the right time. Information management and governance are increasingly important because to control the vast amount of data requires very effective ('best') practices. The findings presented in this paper confirm that advancement of the technology is changing the marketing landscape and impacts every aspect of it. It became clear that digital marketing has become an important channel to collect crucial consumer data to allow analytics-based predictions and advanced decision-making.

All the set objectives have been fulfilled in this paper. Firstly, areas of digital transformation in marketing that have been insufficiently covered by previous rigorous academic research, have been identified. Consequently, researchers can save valuable time when looking for areas related to digital transformation in marketing that require further attention, follow-up research, validation or gathering of new empirical data. This objective was accomplished by creating a comprehensive review of relevant peer reviewed literature in the area of digital transformation of marketing organisations from a data and information management perspective. Secondly, insights into the challenges and implications of big data and ML on digital transformation in marketing organisations are provided, with an overview of peer-reviewed literature outlining hands-on practical applications in specific areas of marketing.

In total, ten opportunities for conducting new research projects in the area of digital transformation in marketing have been identified. Five of the topics are closely related to the issues and challenges of digital transformation, including information systems, processes, and adoption of disruptive technologies. A research gap was also revealed in the area of implementation of ML-driven tools in specific marketing applications - to assist marketing managers with understanding their customers, target segments, and thus, tailoring their marketing strategies. By identifying this research gap and

accomplishing the defined goals, this research study contributes to existing knowledge in the area of digital transformation. The multidisciplinary approach to the research is valuable as it demonstrates the significant impact of disruptive technologies on businesses.

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