A SYSTEMATIC LITERATURE REVIEW OF MACHINE LEARNING TECHNIQUES APPLIED TO PRECISION MARKETING

N. El Koufi [1]   A. Belangour [1]   A. El Koufi [2]   M. Sadiq [1]

1. Laboratory of Information Technology and Modeling (LTIM), Faculty of Sciences Ben M'Sik, Hassan II University, Casablanca, Morocco, elkoufi.nouhaila1@gmail.com, belangour@gmail.com, sad.mounir@gmail.com
2. Laboratory of Analysis, Modeling and Simulation (LAMS), Faculty of Sciences Ben M'Sik, Hassan II University, Casablanca, Morocco, elkoufiamine1@gmail.com

Abstract- The rapid advancement of internet technology in which we reside now has made significant changes in user behavior and consumption habits. As a result, traditional marketing that relies on advertising and traditional techniques becomes unsuitably favorable to a company's long-term growth. Under a big data environment, it is difficult for the classic marketing strategy to precisely attract prospective clients and build targeted marketing recommendations for high-value clients. This paper presents a systematic literature review of machine learning methods applied to precision marketing. We aim to identify, study, evaluate and interpret main findings in this area. This review shows the importance of precision marketing and affords researchers with propositions for future works.

Keywords: Precision Marketing, Machine Learning, Big Data, Systematic Literature Review.

1. INTRODUCTION

Marketing has long been a critical element in expanding companies, engaging clients, and increasing revenue. It considers a communication channel between firms and customers, with the primary goal of attracting and influencing customers' demands and consumption to enhance sales. Moreover, businesses make decisions based on marketing mechanisms. On the other hand, this field suffers from various pressing challenges posed by the growing marketers' competition. Thus, the companies are increasingly being forced to engage in a strong marketing strategy in order to stay competitive.

Under the technological revolution, consumption habits and lifestyles changed. This revolution caused the explosion of transactional data, which drove the world to the big data era. Accordingly, the traditional marketing strategy based on weak tools and techniques such as (multimedia advertising, flyers, etc.) becomes incapable to position quality clients. Thus, companies become increasingly oriented toward creating a powerful precision marketing method based on new and advanced techniques.

Theoretically, Precision marketing is an approach that involves extracting the most suitable human inclination based on customers information collected from their previous transactional data to make the forecast reasoning as near to their desire as possible. Practically, precision marketing has proven to be popular because of new technologies. Moreover, to develop an efficient marketing strategy, it is required to analyze the behavioral requirements of consumers and patterns. Lester Wunderman was the first to propose the concepts of precision marketing. Her work represents a reference for researchers and scholars in the precision marketing area. Afterwards, various authors were developed and gave more details about precision marketing (Zabin, Philip Kotler etc.).

Developing an efficient marketing strategy requires the analysis of the behavior and purchase history of consumers. Accordingly, marketing techniques require the ability to create correct predictions as well. Machine learning technology has advanced significantly since the dawn of the data era. Think to machine learning; it became possible to predict underlying patterns from data. Thus, the combination of machine learning with its ability to produce high-end accurate predictive and precision marketing strategies can develop and serve this field well.

The organization of the rest of this paper is as follow: The second Section presents the background. Then in Section 3, we define research objectives. Next, in Section 4, we introduce the research methodology used. Section 5 describes the protocol proposed. Later, in Section 6, we conduct the review. After, in Section 7, we present the results of this SLR. We discuss the limitation of this work in Section 8. Finally, a general conclusion is presented in Section 9.

2. BACKGROUND

2.1. Precision Marketing

Precision marketing is a type of marketing strategy based on new and advanced information technology. It provides personalized communication between customers

and companies as well as the focus of PM is clearer compared with traditional marketing. Generally, the principal aim of precision marketing is to attract potential customers and make for them predicting thought the nearest to their purchase intuition. Think to precision marketing the enterprises can realize long-term development.

2.2. Machine Learning

Machine learning is the science that makes the machine learn from their experiences without already programmed. One of the most significant features of machine learning approaches is their capacity to make accurate predictions. In addition, it can extract underlying patterns from high dimensional data for exploring them to solve complex problems. Therefore, machine learning technologies made recently substantial progress in business decisions and productions. The three major categories of machine learning algorithms are.

2.2.1. Supervised Learning

Supervised learning is a category of machine learning algorithms that utilize labelled datasets to learn the mapping function from the input to the output using an algorithm. The goal is to predict the output variables for novel input data. Furthermore, there exist two subtypes of supervised learning issues are regression and classification. We can consider a problem belonging to classification issues when the output represents a class such as tasty or not tasty. Whilst regression problem aids in the forecasting of continuous variables. In literature, many scholars have adopted supervised ML algorithms to build predictive models in different domains.

2.2.2. Unsupervised Learning

Unsupervised learning is a type of machine learning algorithm that extract the relationships whiten a dataset. In contrast with supervised learning, unsupervised learning uses unlabeled data for analyzing a novel Input without help. Besides, unsupervised learning aims to understand data by analyzing hidden structures. It's divided into two categories clustering and association [1].

2.2.3. Reinforcement Learning

Reinforcement Learning is a subfield of machine learning algorithms that make an agent learn from experience and sequence of actions by observing their effects in a particular environment. Generally, the agent learns directly from feedbacks generated from the results of action. This feedback can be positive or negative. In the literature, many researchers used reinforcing learning to solve different problems in various areas such as medicine, games, finance etc. [2].
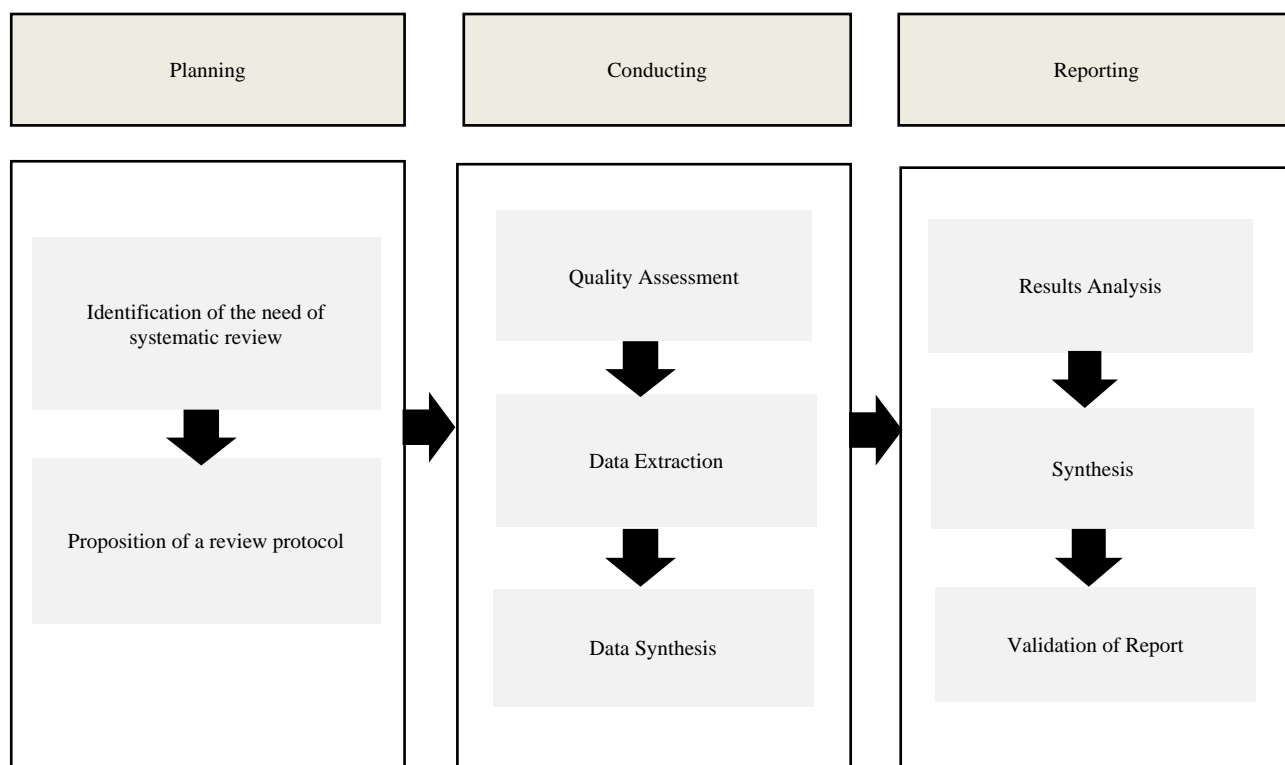

Figure 1. Systematic literature review overall process

3. RESEARCH OBJECTIVES AND METHODOLOGY

After a deep search in many electronic data sources, we haven't found any prior work that provided a systematic overview of the literature on the application of machine learning approaches to precision marketing. Based on this, we aim to present and discuss the main results of the relevant existing works in this field using a strictly scientific method, systematic literature review (SLR), consisting of various critical steps.

Therefore, we will perform a comprehensive study of all available related published papers by presenting the machine learning methods used in this area, discussing which are being found in the current literature by the prior research and evaluating the main results. This research seeks to help the researchers to get an outline of finding, challenges and trends of research in this area. Besides, it supports new research in precision marketing based on ML by providing insights and propositions for future works.

The methodology used in this paper adopts the guidelines proposed by Kitchenham and Brereton [3] to perform a systematic literature review (SLR), which reposed on various well-defined stages to establish a rigorous process. Unlike the traditional literature review, which is based only on the informal or subjective approach for gathering and treatment studies, the SLR follows an accurate method to extract, interpret and evaluate relevant papers. Through these guidelines, we have divided our systematic literature review (SLR) study into three critical stages, as presented in Figure 1, namely planning, conducting, and reporting.

The first step, planning, covers the determination of the motivations, research objective and questions, furthermore the definition of the review protocol for implementing the SLR. Afterwards, the review conduct stage covers the selection of all primary studies that deal with the subject, their quality assessment. Besides, it considers the data extraction method and the extraction of useful information. Reporting phase is the final stage consisting of presentation and interpretation of results.

4. PLANNING

4.1. Identification of the Need for A SLR Review

The objective of our study is to identify and categorize the current state of the art of the application of machine learning to precision marketing. This review seeks to treat and study existing solutions explored in this area and give the gist and suggestions from the previous works. This investigation represents a reference that guides and helps the researchers to discover the existing studies and provides them with plan for future direction.

For choosing the search string, we have selected specific terms relying on common keywords used in the literature relevant to this SLR for collecting all available appropriate papers in the review. Furthermore, we have used all the well-known online scientific databases related to this field: SpringerLink digital library, Scopus, IEEEXplore Digital Library, DBLP, and Science Direct. So, after a deep search on these electronic data sources, we have collected a set of primary studies. Furthermore, we have analyzed the bibliography of each selected paper for obtaining more relevant research. Formally, the string search used to build this systematic literature review mainly includes the union of the keyword "precision marketing" and the specific terms related to this review: ("Precision Marketing") and ("Machine Learning" OR "Machine Learning techniques" OR "ML methods" OR "Machine Learning approaches").

4.2. Research Questions

This investigation presents a systematic review of machine learning techniques applied to precision marketing. It supports new research in this area by giving a thorough analysis, interpretation, and discussion of the literature of our subject published between 2016 and 2021.

To realize this purpose, we proposed the following research questions:
● RQ1: How has machine learning been utilized in precision marketing?
● RQ2: What Machine learning approaches are applied to Precision Marketing?
● RQ3: What is the type of data used in this domain?
● RQ4: What are the components of each study selected in this field?
● RQ5: What are the evaluation metrics used?

4.3. Inclusion and Exclusion Criteria

Firstly, we have used predefined criteria such as the analysis of the (keywords, abstracts, conclusions, title etc.) as initial factors to analyze studies. Then, after the selection of a significant number of papers, we have applied rigorous inclusion and exclusion criteria to select the primary studies the most relevant to our research questions and objectives. We propose the following list of inclusion and exclusion criteria:

4.3.1. Inclusion
● Researches published between 2016 and 2021.
● Articles used machine learning techniques in precision marketing.
● Papers contained keywords related to our subject.
● Research related to our research question and objectives.
● Works published at conferences or journals.

4.3.2. Exclusion
● Workshop reports, technical reports and posters.
● Master thesis and dissertations.
● Articles not written in the English language.
● Papers less than five pages.
● Articles not associated with precision marketing and machine learning.

5. CONDUCTING

5.1. Quality Assessment

For performing an efficient Systematic literature review (SLR), it is critical to choose high-quality studies to obtain good results. Thus, after reading the selected primary papers, we have assessed their quality. The quality assessment is a very significant stage that completely the previous ones, as well as it is a way of measuring the appropriate of the relevant studies. For a more in-depth analysis of study quality in terms of validity, we have defined a quality assessment checklist given in Table 1.

We divided our proposed quality assessment questions into two classes. The first represents the questions that we have affected a high coefficient which is QA1 and QA2, that address the machine learning technique used, architecture of the proposed solution and comparison of the findings with others as shown in Table 2. The second represents the group of the questions that we have affected a low coefficient, which is QA3, QA4 and QA5, as manifested in Table 1 that address the theoretical and experimental results, the limitation of the proposed solution. The final quality score for each given paper is computed using Equation (1) defined as follow:

$$S = \sum_{i=1}^{2} 0.7\overline{W} + \sum_{i=3}^{5} 0.3\overline{W} \quad (1)$$

where, $\overline{W} = \dfrac{\alpha_i C_i}{C_i}$, α_i represents the score value which taken either yes=1, partly=0.5 or no=0 and C_i is the coefficient or the weight.

5.2. Data Extraction Form
Aiming to respond to the research questions that have already been defined (See Section 5) and extract meaningful information, we have applied the data extraction form list to the selected papers. This form involves general relevant points are the title of the research, date of publication, type of paper (journal article, conference paper) and authors names.

Table 1. Quality assessment questions

Class 1		Class 2	
QA	Weight	QA	Weight
QA2 Are the findings deeply discussed and precisely defined?	2	QA1 Is the study has well defined objectives?	1
QA4 Did the research review and compared the findings with the existing solutions of related works?	2	QA3 Did the research provide theoretical and experimental results?	1
		QA5 Did the research present the limitation of the proposed solution?	1

Moreover, specific information related to research questions that we have defined as follow:
- RQ1: ML approaches used in PM area
- RQ2: study components
- RQ3: data sets type used
- RQ4: metric of evaluation employed.

5.3. Data Synthesis
The data synthesis is an analytical stage that combines two points the extraction of data and the summarization of results found from the selected studies to respond to research questions. We have used statistical and descriptive narrative techniques for analyzing the extracted data. We utilized the data visualization method based on illustration tools like (box plot, histogram, etc.) for visualizing, clarify and make a clear presentation of the results.

6. REPORTING
After defining the research protocol and conducting the systematic literature review, it is time to present results obtained from selected papers based on the criteria and research questions explained in the previous section. In addition to the presentation of findings, reporting phase describes the techniques followed. Moreover, a detailed discussion and outline of the selected studies were done.

6.1. Overview of the Selected Studies
The total of the distinguished articles published between 2016 and 2021 is 114 papers. After the analysis of the bibliography of each selected study, we have found 134 research. Then, we have applied the inclusion and exclusion criteria in the chosen papers. As a result, the number of identified articles reduced from 134 to 39. Furthermore, we have measured the quality of opted studies using the quality assessment criteria that we already defined in section 6 to ensure that we have collected the more relevant papers. Therefore, 26 papers selected as final set that responds to our proposed criteria.

On the other hand, since 2018, the rate of publishing in the precision marketing field based on machine learning has increased dramatically. The collected papers have been issued from different sources, principally journals and conferences, with 11 articles published from journals and 15 from conferences.

6.2. Categorization of Chosen Papers
In order to study the distribution of the opted papers, we classified them based on the following factors:

6.2.1. Distribution of Publications by Domain
We have analyzed the distribution of chosen papers by domain. We notice that precision marketing based on ML applies in various fields. Among them are tourism area, e-commerce, and telecom etc. Besides, we have presented the distribution according to the domain in Figure 2. The statistics show that 54% of articles belong to the e-commerce domain, 19% from the telecom field, and 4% from the bank field.
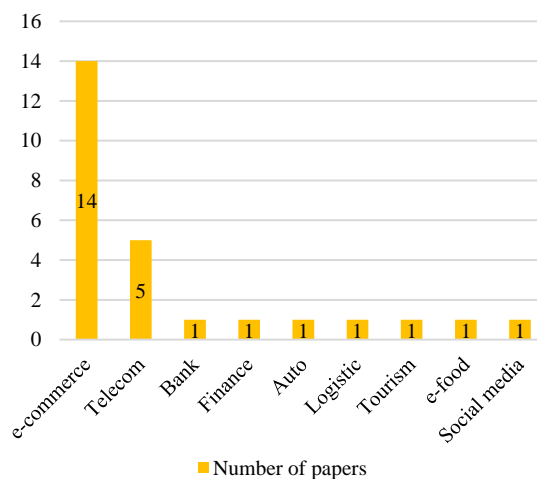

Figure 2. Distribution of publications by domain

6.2.2. Publications Venue and Type

We have presented the distribution of selected studies based on publication venues in Figure 3. Our analysis shows that the opted articles publish in a variety of conferences and journals. The highest number of papers that are relevant published in the Conference with 58 % from the total. There are fifteen conferences represented in the research articles. Among them are International Conference on Signal and Information Processing, Networking and Computers, IOP Conference Series: Materials Science and Engineering, International Conference on Advanced Cloud and Big Data (CBD), IEEE. On the other hand, the articles came from eleven journals in total. Some of them are International Journal of Production Research Taylor Francis, Journal of Intelligent Fuzzy Systems, International Information and Engineering Technology Association, Journal of Physics: Conference Series, International Journal of Production Research.
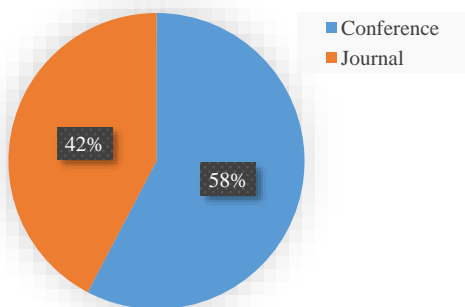

Figure 3. Publication venue

6.2.3. Distribution of Publications Among Years

Regarding the condition of inclusion criteria, we have treated the papers published between 2016 and 2021 to give an overview of the more current literature dealing with the treated area. As a result, we have found 26 articles published in this period that respond to our proposed quality assessment questions and criteria. Figure 4 presents the distribution of the final selected studies after applying the inclusion and exclusion criteria and quality assessment questions over the years. It has clearly shown that from 2017 the interest of the scholar in this domain increased.
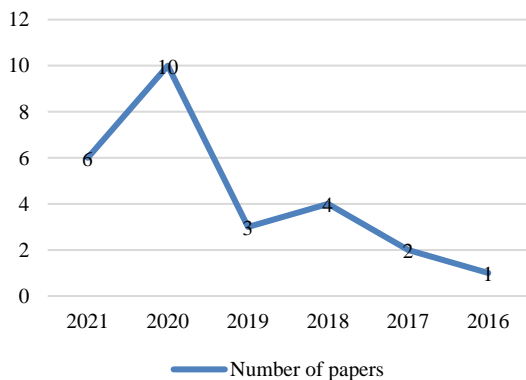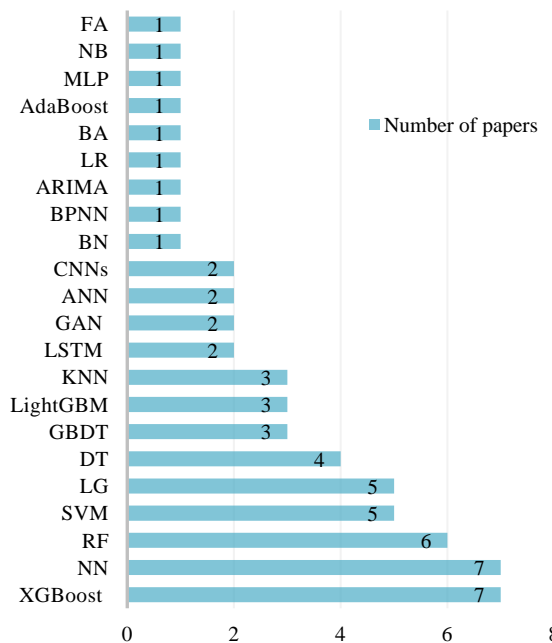

Figure 4. Publications per year

Figure 5. Distribution of the studies by ML method

6.3. Data Extraction Results

After filtering the selected papers, a group of research papers that responds to proposed criteria, quality assessment, and research questions defined in previous sections was attained. Through Table 2, we have summarized the answers to the research questions that we have presented in Section 5. So that includes five columns, each column responding to a specific research question. The first defines the title of chosen articles. The Second column, the corresponding RQ2, represents the machine learning approaches used. The third column represents the type of data used in each selected paper (RQ3). So, in the fourth column, the structure of studies is identified (RQ4). Finally, the final column responds to the question (RQ5).

As illustrated in Figure 5, the ML methods most used in the current literature dealing with our research subject are Random Forest, XGboost, Neural Network, SVM, LightGBM, Logistic regression, Decision tree, KNN and GBDT. Among the previous list, the most ML techniques frequently adopted: XGBoost (eXtreme Gradient Boosting) and neural network with 12 %, Random Forest 10%, SVM and Logistic Regression 8 %, Decision tree 7% and GBDT, LightGBM, KNN 5%. Some papers, as presented in Table 3 combine several ML algorithms. It noted that the use of machine learning techniques in the selected research takes three ways: the use of one ml method, the combination of various ML algorithms, or the combination of ML technique with other methods.

The results found in Table 2 illustrate that various selected studies in this area used real-time data with 77 % of the total. This conduct that the opted papers present the application of their proposed solutions more realistic. Research papers structure from various components. In this SLR, we found that the selected studies combined many elements: Design of experiments, Empirical study, Theory, Case study and documents analysis (Literature).

Table 2. Summary of selected studies

Reference	ML method(s)	Type of data	Typology of study	Evaluation metrics
[4]	GBDT,XGBoost, LightGBM	Real data	DE, ES and DA	Precision, accuracy
[5]	LSTM, GAN, XGBoost	Synthetic Data	Th, ES	AUC-ROC curve
[6]	GBDT, XGBoost LightGBM	Real data	DE, ES, DA	Precision, accuracy, cross-validation
[7]	ANN	Real data	Th, DE, ES	SSE, MSE
[8]	CNNs	Real data	DE, CS, DA	Accuracy
[9]	NN	Real data	Th, DA, ES	Accuracy, precision
[10]	ANN, DT, KNN, LG, SVM	Real data	Th, CS	Accuracy, precision, recall, F1 measure, AUC-ROC curve
[11]	BN BPNN ARIMA	Synthetic Data	DE, Th, ES	MSE
[12]	LR, SVM	Real data	DE, Th, ES, DA	Accuracy, time complexity
[13]	DT, BA, AdaBOOST, NN, RF	Real data	DE, ES, DA	Recall, precision, accuracy, F1-measure, ROC curve
[14]	LR	Synthetic Data	Th, DA	-
[15]	LSTM, GAN, XGBoost	Real data	DE, CS	RMSE, MAE
[16]	KNN, SVM	Real data	Th, DE, DA, ES	Accuracy
[17]	RF	Real data	ES, DA	Recall, precision, accuracy, F-measure
[18]	NN	Real data	Th, ES	Data filtering
[19]	NN	Real data	DE, DA, ES	Cross validation, RMSE
[20]	XGBoost, LightGBM, RF, GBDT	Synthetic Data	Th, ES	F1-value
[21]	LR, RF	Real data	Th, ES	Accuracy, precision, recall, F1-score, ROC
[22]	XGBoost, RF, LR	Real data	Th, ES	Accuracy, recall, AUC
[23]	SVM, MLP, CNN, RF	Real data	DE, ES	Accuracy
[24]	LG, NN	Real data	DE, Th, CS	Overall accuracy, hitting rate, coverage rate
[25]	NB	Real data	Th, DE, DA, ES	Accuracy
[26]	FA, NN	Synthetic Data	Th, ES	Overall accuracy, time complexity
[27]	SVM	Real data	ES	Accuracy, precision, recall, F-measure
[28]	DT	Synthetic Data	Th	-
[29]	XGBoost, NN, DT, KNN	Real data	Th, DE	Precision, accuracy, recall, F1-score

7. LIMITATION OF THIS SYSTEMATIC LITERATURE REVIEW

This study aims to give an overview of the current literature on the application of machine learning in precision marketing. However, we don't treat all existing works because of the unavailability of some papers. In addition, we exclude the articles not written in English. Besides, we have used five online scientific databases that may include all relevant research, but it is not sufficient.

8. CONCLUSUION

In this systematic literature review, we have explored the trend of machine learning techniques applications in precision marketing. We have selected a set of 30 papers published between 2016 and 2021 and responded to the criteria and research questions that we have defined in the planning stage. In addition, it provides an overview of the practical implications and improvement of using machine learning in the precision marketing field. This review reposed on accurate method and well-defined stages associated. It begins by reviewing protocol identification, review conduct and presentation of the results. Moreover, this study gives a good reference for developing new solutions to improve precision marketing based on machine learning. In future work, we will propose solutions for resolving some problems in this field by benefiting from this SLR.

NOMENCLATURES

1. Acronyms

ML	Machine learning
GBDT	Gradient-boosted decision trees
XGBoost	eXtreme Gradient Boosting
LightGM	Light Gradient Boosting Machine
LSTM	Long Short-Term Memory
GAN	Generative Adversarial Networks
ANN	Artificial neural network
CNNs	Convolutional neural networks
NN	Neural network
DT	Decision Tree
KNN	K-nearest neighbor
LG	Logistic Regression
BN	Bayesian network
BPNN	Backpropagation neural network
ARIMA	Autoregressive integrated moving average
LR	Linear Regression
BA	Bagging classifier
AdaBoost	Adaptive Boosting
RF	Random Forest
BPNN	BP Neural network
MLP	Multi-Layer Perceptron
NB	Naive Bayes
FA	fuzzy method
DE	Design of experiments
ES	Empirical study
DA	Documents analysis
Th	Theoretical
CS	Case study

REFERENCES

[1] V. Jain, A. Jain, V. Garg, et al., "Siamese Neural Networks for Pandemic Detection Using Chest Radiographs", International Journal on Technical and Physical Problems of Engineering (IJTPE), Issue 51, Vol. 14, No. 2, pp. 104-110, June 2022.

[2] N. Atashafrazeh, A. Farzan, "A Review of Using Machine Learning Algorithms for Image Retrieval Words", International Journal on Technical and Physical Problems of Engineering (IJTPE), Issue 20, Vol. 6, No. 3, pp. 139-144, September 2014.

[3] B. Kitchenham, P. Brereton, "A Systematic Review of Systematic Review Process Research in Software Engineering", Information and software Technology, Vol. 55, No. 12, pp. 2049-2075, December 2013.

[4] J. Gao, Y. Qin, X. Cheng, et al., "A Best-Marketing Time Prediction Algorithm Based on Big Data Analytics", Signal and Information Processing, Networking and Computers, Springer, pp. 746-754, Singapore, 2020.

[5] G. Duan, X. Ma, "A Coupon Usage Prediction Algorithm Based on XGBoost", The 14th International Conference on Natural Computation, Fuzzy Systems and Knowledge Discovery (ICNC-FSKD), IEEE, pp. 178-183, July 2018.

[6] J. Gao, T. Zhang, J. Guan, et al., "A Gender and Age Prediction Algorithm Using Big Data Analytic Based on Mobile APPs Information", International Conference on Signal and Information Processing, Networking and Computers, Springer, pp. 516-524, Singapore, 2018.

[7] J. Cheng, "An Evaluation Strategy for Commercial Precision Marketing Based on Artificial Neural Network", Rev. Intelligence Artificially, Vol. 34, No 5, pp. 637-644, 2020.

[8] M.C. Chiu, K.H. Chuang, "Applying Transfer Learning to Achieve Precision Marketing in an Omni-Channel System; A Case Study of a Sharing Kitchen Platform", International Journal of Production Research, Vol. 59, No. 24, pp. 7594-7609, 2020.

[9] H. Liu, "Big Data Precision Marketing and Consumer Behavior Analysis Based on Fuzzy Clustering and PCA Model", Journal of Intelligent and Fuzzy Systems, Vol. 40, No. 4, pp. 6529-6539, 2021.

[10] Q. Liu, S. Cai, X. Gu, "Construction of the Luxury Marketing Model Based on Machine Learning Classification Algorithm", Scientific Programming, pp. 1-11, 19 October 2021.

[11] L. Pang, Y. Liu, "Construction and Application of a Financial Big Data Analysis Model Based on Machine Learning", Rev. Intelligence Artificially, Vol. 34, No. 3, pp. 345-350, 2020.

[12] Q. Wang, R. Cai, M. Zhao, "E-Commerce Brand Marketing Based on FPGA and Machine Learning", Microprocessors and Microsystems, p. 103446, November 2020.

[13] R. Abakouy, A. El Haddadi, L. Elaachak, "Machine Learning as an Efficient Tool to Support Marketing Decision-Making", The Third International Conference on Smart City Applications, Springer, pp. 244-258, Cham, Switzerland, 2019.

[14] T. Yan, L. Pengfei, "Marketing Customer Response Scoring Model Based on Machine Learning Data Analysis", Journal of Intelligent and Fuzzy Systems, Vol. 40, No. 4, pp. 6445-6455, 2021.

[15] S. Wang, Y. Yang, "M-GAN-XGBOOST Model for Sales Prediction and Precision Marketing Strategy Making of Each Product in Online Stores", Data Technologies and Applications, Vol. 55, No. 5, pp. 749-770, 2021.

[16] S. Zhang, P. Liao, H.Q. Ye, Z. Zhou, "Multiple Resource Allocation for Precision Marketing", Journal of Physics: Conference Series, IOP Publishing, Vol. 1592, No. 1, p. 012034, 2020.

[17] G. Zhu, Z. Wu, J. Cao, J. Gu, "Online Tourism Purchase Analysis and Prediction" The Sixth IEEE International Conference on Advanced Cloud and Big Data (CBD), pp. 171-176, 2018.

[18] S.Y. Liu, "Precision Marketing Scheme Based on Integrating Spatio-Temporal Data Clustering and Neural Network", Journal of Physics: Conference Series, IOP Publishing, Vol. 1087, No. 3, p. 032014, 2018.

[19] A.Y.L. Chong, E. Ch'ng, A. Bose, "Predicting Consumer Product Demands via Big Data: The Roles of Online Promotional Marketing and Online Reviews", International Journal of Production Research, Vol. 55, No. 17, pp. 5142-5156, 2017.

[20] X. Zhai, P. Shi, L. Xu, Y. Wang, X. Chen, "Prediction Model of User Purchase Behavior Based on Machine Learning", IEEE International Conference on Mechatronics and Automation (ICMA), pp. 1483-1487, Beijing, China, 2020.

[21] Y. Zhang, "Prediction of Customer Propensity Based on Machine Learning", Asia-Pacific Conference on Communications Technology and Computer Science (ACCTCS), IEEE, pp. 5-9, Shenyang, China, 2021.

[22] S. Qiongyu, "Prediction of O2O Coupon Usage Based on XGBoost Model", The 11th International Conference on E-business, Management and Economics, pp. 33-36, Beijing, China, 2020.

[23] W.H. Hu, S.H. Tang, Y.C. Chen, C.H. Yu, W.C. Hsu, "Promotion Recommendation Method and System Based on Random Forest", The 5th Multidisciplinary International Social Networks Conference, pp. 1-5, New York, USA, 2018.

[24] H. Zhang, L. Zhang, X. Cheng, W. Chen, "A Novel Precision Marketing Model Based on Telecom Big Data Analysis for Luxury Cars", The 16th International Symposium on Communications and Information Technologies (ISCIT), IEEE, pp. 307-311, Qingdao, China, 2016.

[25] H.K. Rao, Z. Zeng, A.P. Liu, "Research on Personalized Referral Service and Big Data Mining for E-commerce with Machine Learning", The 4th International Conference on Computer and Technology Applications (ICCTA), IEEE, pp. 35-38, Istanbul, Turkey, 2018.

[26] K. Xiao, X. Hu, "Study on Maritime Logistics Warehousing Center Model and Precision Marketing Strategy Optimization Based on Fuzzy Method and

Neural Network Model", Polish Maritime Research, Vol. 24, pp. 30-38, 2017.

[27] L. Jiang, "Support Vector Machine (SVM) Marketing Strategy Analysis Method Based on Time Series", IOP Conference Series: Materials Science and Engineering, IOP Publishing, Vol. 750, No. 1, p. 012148, 2020.

[28] Y. Jia, K. Chao, X. Cheng, L. Xu, X. Zhao, L. Yao, "Telecom Big Data Based Precise User Classification Scheme", IEEE Smart World, Ubiquitous Intelligence and Computing, Advanced and Trusted Computing, Scalable Computing and Communications, Cloud and Big Data Computing, Internet of People and Smart City Innovation, pp. 1517-1520, Leicester, UK, 2019.

[29] M. Du, Z. Yu, T. Wang, X. Wang, X. Jiang, "Xgboost Based Strategic Consumers Classification Model on E-commerce Platform", The 6th International Conference on E-Business and Applications, Kuala Lumpur, Malaysia, pp. 48-53, 2020.

BIOGRAPHIES

Nouhaila El Koufi was born in Casablanca, Morocco, on November 6, 1997. She obtained her Master of research degree in Data Science and Big Data from High National School for Computer Science and Systems Analysis (ENSIAS), Morocco in 2020. She is currently a Ph.D. student on IA and Big data area at Laboratory of Information Technology and Modeling (LTIM), Faculty of Sciences Ben M'sik, Hassan II University, Casablanca, Morocco. Her current researches interests focus on AI, big data, recommendation system.

Abdessamad Belangour was born in Casablanca, Morocco, on April 9, 1975. He received his engineering and Ph.D. degrees from High National School for Computer Science and Systems Analysis, ENSIAS, Morocco. Currently, he is a Full Professor at Department of mathematics and computer science, Faculty of Sciences Ben M'Sik, Hassan II University, Casablanca, Morocco. His research interests focus on IA, model-driven engineering approaches and their applications on new emerging technologies such as big data, business intelligence, cloud computing, internet of things, real-time embedded systems, etc. His research interests are in the application of artificial intelligence to power system control design, dynamic load modeling, power system observability studies and voltage collapse.

Amine El Koufi was born in Casablanca, Morocco, on April 17, 1992. He received a five-year degree in Applied Mathematics from Faculty of Sciences Ben M'sik, Hassan II University, Casablanca, Morocco, in 2017 and the Ph.D. degree in Stochastic Analysis from the same university, in 2020. Currently, he is a member of the research team "LAMS" of the Faculty of Sciences Ben M'sik. His main research interests are stochastic analysis and applications, mathematical modelling.

Mounir Sadiq was born in Sidi Slimane, Morocco, on June 28, 1971. He received the B.Sc., M.Sc. degrees and Ph.D. degrees from Faculty of Sciences Ben M'sik, Hassan II University, Casablanca, Morocco, all in Computer science, in 1996, 2005, and 2010, respectively. He received his Ph.D. degree from the same university. Currently, he is a Professor at Department of Mathematics and Computer Science, Faculty of Sciences Ben M'Sik, Hassan II University, Casablanca, Morocco. His research interests focus on e-learning, data science, software etc.