THE APPLICATION OF PREDICTIVE ANALYTICS:BENEFITS, CHALLENGES AND HOW IT CAN BE IMPROVED

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Abstract: In fact, with the big data spread and continuous increase analytical systems get more important role and necessity in organizations. Thus, Predictive analytics in general are used to detect the relationships and patterns in data in order to predict the future by analyzing the past and taking better preventive decisions.But, their purpose of use is varied from an industry to another. This paper, describes the purpose of predictive analytics use in many industries and how the predictive analytics have been used as a solution to solve many problems in different industries.The predictive analytics have many benefits such as reduce and prevent risk, save time, cost and better management of resources in addition to the ability to take better strategic decisions based on fact not on intuition. Furthermore, the research in the area show challenges such as to get real, sufficient and clean data to test models developed. Moreover, it illustrates the weaknesses in the research area such as the focus on the development of models only, the wrong choice of models variables and algorithms which affect the final results of predictions, and what can be improved in the future research.

*Keywords:*Predictive analytics, models, algorithms, industries, management tasks

I-   INTRODUCTION

predictive analytics are defined as technologies and methods that allow organization to detect orientations and patterns in data, developing models, and testing a huge number of variables. The predictive analytics are used by organizations to achieve their

desired goals and increase their profits. Also, the research reports show that its estimated to have a grow in the predictive

analytics market from $1.70 billion in 2013 to $5.24 billion in 2018 with CAGR rate of 25.2% [1].

II-   LITERATURE REVIEW

II-1- predictive analytics

In order to introduce what is predictive analytics we need to know where it comes from. Thus, firstly the umbrella that covers

those systems is called business intelligence (BI). Business intelligence is a combination of tools aiming to enhance the decision

making in an organization by transforming data into beneficial information and knowledge which is extracted by utilizing data

mining tools and analytical techniques. BI systems help in analyzing and improving organization's performance, creating new

strategies to enhance the revenue and profit of the organization. Thus Data mining is part of Business intelligence functionalities

as defined by Gartner who described BI as a software platform delivering 14 capabilities divided into three groups of

functionalities including integration, information delivery and analysis functionality which contain the data mining and predictive

modeling. While data mining is considered as the automated process to detect the unknown patterns in the structured data of the

organization[2][3]. Another one [4] describes data mining as the process to collect, filter, prepare, analyze and store data that

will be used to create useful knowledge and supporting the data analytics and predictive modelling. In fact, data analytics is

divided into four types as follow:

- The descriptive analytics: which describe the current situation and answer the question what is happening now?

- The diagnostic analytics: which answer the question Why this is happening?

- The predictive analytics: which answer the question what will happen in the future?

- The prescriptive analytics: which answer the question what is the right choice or solution?

Actually, for the predictive analytics process it pass by five phases, the identification of the problem, the collection and

preparation of the data, analysis of the data and the development of the model, the deployment, observation and control of

the predictive model. Moreover, predictive analytics [5] can be defined as a prediction of the future by analyzing the past

performance and studying the historical data to uncover the relationships and patterns in these data.While [6] add that the

predictive analytics help organizations' in predicting risk, tendency, and in attaining better revenues by enhancing their key metrics and making strategic corrections and this is by making accurate predictions from structured and unstructured information. Actually, those predictions are done based on models.

III-   2- Models and Algorithms used in predictive analytics

Thus, predictive models are creating during the predictive modelling process to discover the patterns between dependent variables and explanatory variables and predicting an outcome [6][7]. Various algorithms are used:
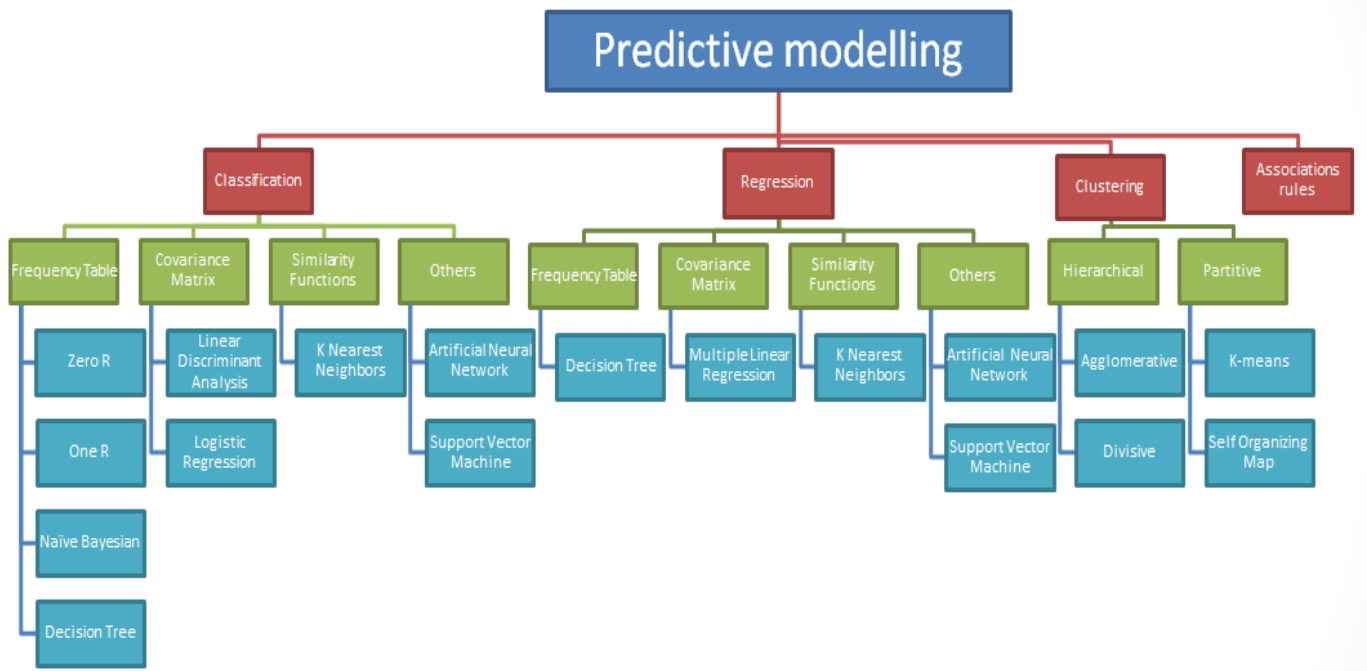
Classification: decisive outcome, it's for predicting the value of decisive variable (class or target) by constructing a model based on one or multi decisive or numerical variables (attributes or predictors).

Clustering (unsupervised learning): assigning observations into clusters, each cluster contains the similar observations and data. This process helps in discovering the unknown relationships in a dataset.

Association rules: to find important associations in the observations, which mean association rules find all item sets that have support greater than the minimum support and then using the large item sets to generate the desired rules that have confidence greater than the minimum confidence. An example of association rules application is market basket analysis which is a modelling technique that can be described simply as if a customer buys a specific set of items he will more or less probably buy another set of items.

Regression: numerical outcome, predicting the value of target (numerical variable) by constructing a model based on one or more predictors (numerical and categorical variables).

Actually, there are different families of these algorithms and different ways of measuring the error as show figure 1 below.

Figure 1:families of algorithms used in predictive modelling

MeryemOuahilal, Mohammed El Mohajir, Mohamed chahhou, BadrEddine El Mohajir (2016)

II -3- Application of predictive analytics in different industries

Predictive analytics in general are used to detect the relationships and patterns in data in order to predict the future by analyzing the past and taking better preventive decisions. Thus, the predictive analytics aim of use differ from one industry to another, for instance a marketer can use the predictive analytics to predict the customers' response to an advertising campaign, or a product seller can use it to predict the movement of product prices, or it can be used to detect trends such as in banks if a manager wish to recognize the most profitable customers, or alert a credit card customer to a probable fraudulent charge. Thus the predictive analytics help in answering many questions such as What will happen if the demand of products decrease? Or if suppliers' prices increase? What is the risk to lose money a new business? [8]

In fact, in the education sector as one of the important sectors the predictive analytics have been used for different purposes and by using different models and tools. For example, a study focus in behavioral analytics in university in order to

predict whether students are vulnerable to deviant ideologies which can lead to terrorism [9]. While, another study shows the

necessity and benefit from using the predictive analytics in the educational sector which will help the educational institutions to

increase the retention of student and enhancing their results and achievements. The researchers focused on the use of

classification algorithms especially the decision tree to get better prediction results. The lack in this study is that it's not specific

and not tested by real world data [10]. In the same industry, another research aimed by the use of a performance analytic

methodology to predict the final students' performance in a specific course during the semester and mark the ones that will fail

and have low performance in exams. The researchers used the decision tree algorithm to predict the students' final performance

results. Actually, this research will be more beneficial by doing deeper analysis of discovering the students' mistakes in the

exams, their learning interactions with the educational system by using different algorithms such as association rule algorithm

[11]. Moreover, [12] analyzed the students' data in order to predict the drop out feature of students and discovering the main

factors that influence the open sources dropping by students. Thus, to do this analysis the researchers applied feature selection

algorithms by using WEKA tool and then classification algorithms. Thus, the results will be more accurate with the use of different

algorithms such as association and clustering techniques.

Actually, predictive analytics have been used also in business and market in general and in different countries. For instance,

one of the studies done on one of the governmental organizations in Singapore described the characteristics of the procurement

dataset specifics and its implications on the future purchase problem and solve it by using Markov chains model. In fact, the aim

of the study was to cover the greater portion of the future purchasing by predicting the larger number of requesters. To attain this

goal some algorithms have been evaluated such as probability distribution analysis, simple random sampling, sequence analysis,

and Markov chains. Although, after the test the best approach among the algorithms used was Markov chains but in general the

results were unsatisfactory to be practically applied. Thus, for requesters where prediction was possible (accuracy > 0) Markov

approach got 0.31 accuracy with 6.64% dataset coverage without clustering; and 0.26 accuracy with 34.27% coverage with

clustering. In fact, the integration of clustering reduced the accuracy, but it notably assisted to make predictions for more

requesters. This research could get better results with the use of association rules algorithms in order to discover better the relation between the study variables [13].

In India, a study was done in the Indian green coffee supply chain to develop a multi criteria decision support system based on predictive analytics to help stakeholders having better purchases and the ability to take better sales decisions and knowing the requirements of the green coffee supply chain market. Thus, the system must be more dynamic due to rapid market changes [14].

Moreover, in the IT industry a study used predictive analytics to build a model that analyze the factors affecting the chances to loss or win the IT services deals for IT service providers. This study benefits could be to better take decisions for the preparation and allocation of needed resources, and the attributes of sales pursuit may give awareness to what to do to raise the chances to win sales pursuits in the future. The model developed have been applied in two ways, firstly in the beginning of prioritization of the validated deals in the list, thus the model was utilized to give and early ranking list of deals with the chances of winning. While, the second way to apply the model was by the ideal distribution of sales force to following deals in order to increase the sales revenue. Thus, the model be improved by providing online prediction of deal outcome during the sales pursuit process and it can be extended by integrating this predictive model in another optimization model to determine the ideal bidding price [15].

Additionally, predictive analytics have been widely used in manufacture sector. For instance, in one of the research in manufacturing in metal cutting industry aiming to predict power consumption by utilizing big data infrastructure, the researchers created a prototype system by utilizing open platform solutions comprising Hadoop Distributed File System (HDFS), MapReduce, and a machine-learning tool. The researchers adopt a data-driven analytic modeling approach based on feature vectors which are n-dimensional vectors of numerical or nominal features that classify a machining operation. But the lack in the study was to acquire real data and integrating the analytic systems and the big data infrastructure and the integration of optimization modeling [16].

Furthermore, in a different way of use in a study done in Pakistan the focus was to minimizing the loss of human life from the drone attack by predicting the future attack frequency and the prospective losses and injuries and its adoption by the government. The tool used to build the predictive models was the IBM SPSS, and the selection of the predictive algorithm needed and its parameters was automatic. Actually this study would get better results if the selection of algorithms was manual to get better accuracy [17].

Moreover, predictive analytics can be used in the social media by social media companies and benefit from social media data while, [18] show the importance to extract valuable information from the social media data and use it for the creation of predictive models. Thus, the framework created merge data from multi social media sources for the analysis and it integrate feature selection, similarity metrics and sentiment and trend analysis by using R, WEKA, D3 and JSON [18].

While, in a different sector the predictive analytics have been utilized in transportation, where researchers present a smart public transportation decision support system to predict the times of bus arrival in short and long term. Thus to attain this, the researchers used clustering model to detect the patterns of bus performance, then a real-time vehicle schedule commitment and prediction model to identify the time of bus arrival and irregular operations, then the approach have been empirically validated by utilizing real-world data. Thus the model show reduction error and improvement in predicting delay [19]. Furthermore, in another sector which is the stock market where the researchers created a model to optimize prediction of products and stock market indications. Thus this model allows to set the stock indications future values and trading of financial services which will allow investors to increase significantly their returns on investment and reduce the risk [20].

Finally, one of the important industries that use the predictive analytics is the healthcare sector. For instance, a study in an Australian hospital was designed to develop a framework and a prototype to benefit from the Business Analytics techniques in the context of oncology and cancer care [21].

II -4- Application of predictive analytics in management tasks

In fact, nowadays the predictive analytics have been used in the diverse administrative tasks in organizations. Actually, some organization now face the challenge of the rigidity of enterprise resource planning (ERP) systems to adjust to the changes in the process in the organization and there is a significant continuous increase in the amount of data in the ERP transactional systems. Thus, the emerge of predictive analytics in the ERP systems to analyze the data will be a beneficial way to discover the risks and opportunities for the organization. While, the goal of the research is to implement a predictive analytics framework to automate the operational decision making in ERP systems. Moreover, to handle the various stages and parameters of business frameworks some important models need to be used such as the Analytical Decision Management (ADM) decision services and Business Rules. The ADM model is utilized to produce weekly predictions for putting the sales aims, levels of production, and distribution plans in resource planning systems. In fact, the predictive analytics, ADM models, Business intelligence systems and optimization are usually used not for the strategic decisions but for tactical or operational purposes in short term. The table 1 below show different practices of ADM in organization to deal with business practices, regulations and policies [6].

ADM Task	Typical Actions Performed
Connect to big data	Use predefined data sources
Define global selections	Include/Exclude data from analysis
Define desired outcomes	Define allowed answers in form of tree
Optimize & Simulate outcomes	Define trade-off matrices to balance business rules & predictive analytic models
Deploy into operational systems	If the results are acceptable, deploy decision services.
Reporting	A set of reports are provided to measure decision performance and outcomes
Optimization of Results	Optimization provides the highest value in situations where the complexity is overwhelming to the human

Table 1: Tasks executed by the ADM model

PrasadaBabu, S.HanumanthSastry (2014)

The results of this research show an importance to choose rightly the variables used in the model in order to get better quality in the resulted predictions. While the limitation of this study is its focus in the tactical and short term decision without investigating the use of predictive analytics to improve and make strategic decisions [6].
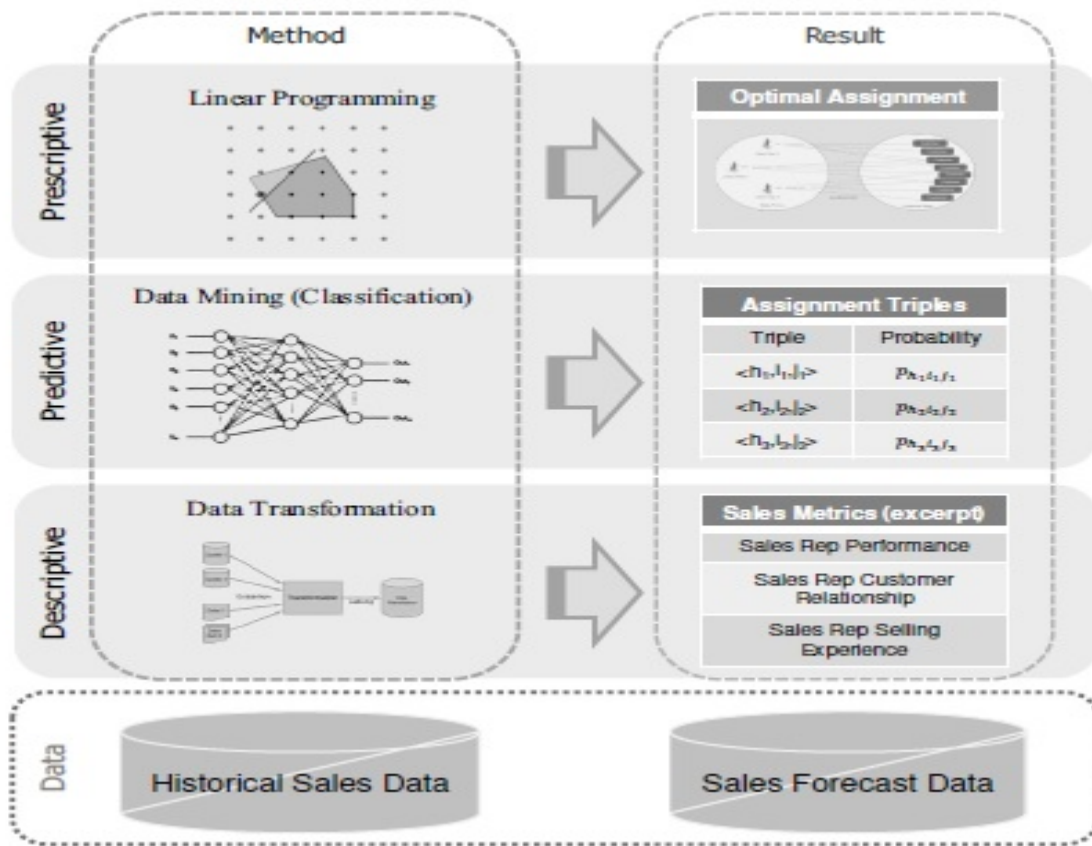
In a different purpose and in order to enhance the organization productivity and reducing time of offering services, the business process prediction analytics are used widely. Thus, for organizations to meet the Service Level Agreements (SLAs) signed with the customers, it need to forecast event logs and processes, realize their patterns, and predicting the workflow time. In fact, this research focus on firstly developing a framework to simplify the emulation of prediction analysis techniques and business process; then secondly to create a prediction model Hidden Markov Model (HMM) to predict the time needed to complete of business processes by discovering the patterns on workflows present in the historical event logs; and a test prototype which integrate the architecture suggested and the prediction analysis techniques. Actually, in the first stage the researchers implemented 4 prediction techniques the regression model, descriptive statistics, annotated transition system and the hidden Markov model. But, after the test and evaluation of the 4 mentioned models the results show that hidden Markov model gives the higher prediction results accuracy when compared to other models that's why it has been adopted in this study. The limitations of this study is the focus on one parameter without taking into consideration other parameters that may affect the

business processes such as the capabilities and the readiness of computing and human resources. Furthermore, the suggested

model need to be tested by using real world data to improve its accuracy and effectiveness [22].

Another research addresses the issue of disconnection, fragmentation and decentralization of the campaign management

support systems (CMMS). Thus, this research aim is to list the requirement of a centralized campaign spreading and analytics

systems with the ability to discover the multistage and cross-campaign weaknesses and assisting in campaign management.

Indeed, the focus is to create a centralized campaign analytics which order synchronically all the actual campaigns in the

organization and simplifying the comparison between different offers and operations across various product lines by utilizing a

real time predictive modeling. Furthermore, to describe the intelligence phase in the predictive model a SEMMA (Sample,

Explore, Modify, Model, and Assess) methodology was used it comprise a database, modelling expertise and statistical analysis

methods. Another methodology called DEEPER (Design, Embed, Empower, Performance measurement, Evaluate and Retarget)

was used to integrate the intelligent phase depicted by SEMMA and integrate it to the campaign management strategy. In fact,

the development of predictive analytics systems gives organizations the opportunity to centralize the data sources and integration

of the enterprise information and applications and delivering faster decision making by the real time data warehousing. But

unfortunately, the current use of predictive analytics models still divided and fragmented into parts for each business unit. Indeed,

a real life practice of the CMMS for instance in LinkedIn where the predictive analytic systems are utilized to raise the site traffic

and the paid membership. Thus, they make messages personalization by utilizing the real time data. When performing

campaigns, the analyses results of LinkedIn performance in "refresh, remodel or do nothing" decisions. Another example is

Yahoo! Which follow the approach of multi-stage to campaigns with an "upper funnel," and a "lower funnel" [1].

Moreover, currently the solution selling organizations pertain and get closer to customers by the assigned sales team which

consist of team with different responsibilities and skills. Thus, research focus on developing a system for organizing the sales

force designation by using predictive analytics that use mining technique on the historical sales data aiming to forecast the sales

effect for any specific designation of sales teams to the accounts of customers and prescriptive analytics that use the model of

linear programming to compute the optimal designation which maximized the revenue. Thus, this system will help firstly in the

designation of sales team to customer accounts, secondly it assists the sales managers in organizing the teams' designations.

Moreover, this proposed system had many operations and benefits to enhance the sales force designation such as the analysis

of the history of sales force and What-if analysis of scenarios of sales force designation. The figure 2 below shows the different

layers of the system development [23].

Figure 2: system development layers

Johannes Kunze von Bischhoffshausen, Markus Paatsch, Melanie Reuter, Gerhard Satzger, Hansjoerg Fromm (2015)

The first layer is the descriptive layer which indicate gaining perception from the historical data. The data used in this system is

the historical sales opportunity records that are generating when a sales person sell a service or a specific product to a customer.

Moreover, the historical data comprise diverse information about the customers, the products or services, and sales team

members. This data is then converted to significant metrics such as for instance the number of chances of a sales person in a particular industry and the win ratio of sales team. In addition, these metrics give the base to realize the predictive model in the second predictive layer where the metrics are calculated at a specific time and they are utilized as a predictor to make predictions for the target variable. Then this historical data can be employed to train and assess the predictive model performance and accuracy. In this model due to binary nature of the targeted variables the researchers had use the classification algorithms to train the machine learning models. For this, the classifier used to train data is multilayer perceptron neural networks which is employed to model the non-linear relationships. The, the last third layer is the prescriptive layer which make analytics to suggest decisions. The input data is obtained from the predictive model, then it computes the optimal designation the maximize the revenues. The gap in this research was the use data limited in time, amount and integrity which does not reflect the real effectiveness and efficiency of the developed system. And there was no test and assessment of the system performance [23].

While a different model was developed to predict the chances of success and failure of a project during and after its development. This, model benefit is that it can save and reduce many financial expenditures by predicting the software functionality before its integration and it assist the managers to take better decisions about the projects that can continue development and the one that must be cancelled. But this work still need improvements and tests to validate its efficiency [24].

While, a research reviews some techniques to predict the stock market movements. Thus, regression algorithms are known as beneficial tools for the time-series prediction and modelling. For this, a comparison of financial prediction ability was made between three regression algorithms which are the Decision tree regression, Support Vector regression, and Multiple Linear regression. Thus, to dot his evaluation of algorithms performance the experiments was done by utilizing the L'Oréal financial data. The results shown that Support Vector regression algorithm performed and make better predictions than other compared algorithms [7].

III-   LITERATURE FINDINGS

The table 2 below show the usage of predictive analytics in term of sectors, the purpose of use and the most algorithms and

tools applied

Sector	Goals of PA use	Algorithms	Tools
Business/marketing	Marketer can use PA to predict the customers' response to advertising campaign		
Banks	To predict the most profitable customers or to alert credit card customer to a probable fraud		
Business/sales	Product sellers can use PA to predict the movement of product prices		
Education	Predicting student abnormal behavior, Predicting students' results, Predicting the performance of students in a specific course	Classification Decision tree Feature selection	WEKA
Governmental organizations	Predicting purchases	Markov chains model Clustering	
Supply chain	Predicting the requirement of green coffee supply chain market		
IT services providers	analyzing factors that affect the chance to win	predictive models and	

	or loss IT services deals	optimization model	
Manufacture sector	Predicting the power consumption in a metal cutting industry	feature vectors n-dimensional vectors	Hadoop HDFS Map reduce Machine learning tool
Aviation	predicting future attack frequency and the prospective losses and injuries	automatic selection of algorithms	IBM SPSS
Social media	analyzing sentiment and trend analysis by using social media data		WEKA JSON D3 R
Public Transportation	predicting the time of bus arrival	Clustering model	
Stock market	optimizing prediction of products and stock market indications		
Healthcare sector	benefiting from predictive analytics in oncology and cancer care		

Table 2

In the table 3 below we can see some of the problems in management and systems in organization that have been resolved through the application of predictive analytics

Purpose of usage	Solution by the application of PA
the rigidity of enterprise resource planning (ERP) systems to adjust to the changes in the process in the organization	implement a predictive analytics framework to automate the operational decision making in ERP systems.

Enhancing the organization productivity and reducing time of offering services. to meet the Service Level Agreements (SLAs) signed with the customers	create a prediction model Hidden Markov Model (HMM) to predict the time needed to complete of business processes
the issue of disconnection, fragmentation and decentralization of the campaign management support systems (CMMS)	to create a centralized campaign analytics which order synchronically all the actual campaigns in the organization and simplifying the comparison between different offers and operations across various product lines by utilizing a real time predictive modeling.
To get closer to customers in the solution selling organizations by the assigned sales team	developing a system for organizing the sales force designation
Reducing financial expenditures	predict the chances of success and failure of a project during and after its development
Stock market movements	Predicting the stock market movements

Table 3

In fact, from the previous studies in predictive analytics we can see the benefits of its application such as the reduce and the prevention of risk, it allows to manage the resources, reduce time, allow to make better decisions, and save costs.   While, in the other hands many of the researches done about the predictive analytics which in majority focused on the creation and development of new models to enhance the use and results of predictive analytics application faced some challenges such as getting real, sufficient and clean data to be able to test their models and discover its effectiveness. In addition, some models did not get the desired results due to the wrong choice of algorithms and variables. Moreover, the models applied must be dynamic and the predictive analytics must be integrated with other organizations systems to get better results and benefits.

IV-   Conclusion

Indeed, predictive analytics are systems that have been used in different industries for different purposes some get the desired results and others not. While most of the research focused on the development and creation of models. But, is this sufficient? What the predictive analytics systems application lack to be able to get better results and benefit more from its use? Many organizations don't know what to do and where to start, those in the future work we will try to answer those question and focusing on how to apply predictive analytics systems.

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