Design of Marketing Scenario Planning Based on Business Big Data Analysis

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Abstract. As the amount and the type of data for business decision making are rapidly increasing, the importance of big data analytics is gradually critical for making effective business strategy. However, big data analytics based decision making systems basically requires distributed parallel computing capability in order to make timely business strategy recommendation via processing huge amount unstructured as well as structured business data. We introduce a big data analytics system for automatic marketing scenario planning based on big data platform software such as Hadoop and HBase. The analytics methodology for scenario planning is based on prescriptive analytics which is the most advance methodology consisting of generation of business scenarios and their optimization, among the three analytics of descriptive, predictive, and prescriptive analytics. Additionally, we developed a prototype of marketing scenario planning system and its graphical user interface, as well as the system architecture based on Hadoop eco-system based distributed parallel computing platform.

Keywords: Business intelligence · Prescriptive analytics · Big data · Marketing scenario · Scenario optimization

1 Introduction

With the advent of gigabit-level ultrafast Internet access to communication networks, and the subsequent development of financial information infrastructure, such as business transaction systems, businesses and entrepreneurs now possess a vast amount of sales-related databases. However, it is not simple for managers and business owners to use these data for detecting new business opportunities and attracting new clients to continue improving business performance. New clients can be either those who are already habitual consumers of their products and services, or those who visit their points of sale (POS) less frequently. Managers usually set business objectives that target these client clusters. Once the business objectives are established, concrete strategies should be set up, such as discounts and leaflet advertising, to achieve objectives.

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In most cases, decision makers are content with establishing objectives and strategies by manually analyzing the various business information resources they collect in their own ways, and using such information resources as check items for decision making regarding business actions. In some cases, decision makers do not even possess storage devices or analysis software for various POS data because of the financial burden of purchasing and operation. Such manual and unsystematic approaches to management have two problems in terms of accomplishing objectives: first, the decision makers can present a non-objective direction in the strategic planning processes; second, the expenditure saved from the costs of introducing automatic management data processing infrastructure can be easily outweighed by the costs of human resources and wasted time for manual data processing.

The present paper proposes a prescriptive analysis system that evaluates sales and logistical data in and around POS, and suggests marketing scenarios for management-related decision-making to business owners who cannot afford management information analysis systems. The proposed system stores general management information using HBase, which is a large-scale database management system (DBMS) based on a distributed/parallel database, performs high-speed computation of the stored data necessary for calculating strategic models for establishing marketing scenarios, and stores the output data. Users can then choose basic business information associated with their businesses, as well as additional business strategies interesting for their businesses, and apply them to the decision-making processes to finally find efficient marketing scenarios.

2 Related Works

Business Analytics (BA) refers to a series of analytic techniques used for identifying current problems by analyzing past business achievements or performing recurrent processes, such as simulation, in order to derive optimal strategies to overcome the problems. BA is largely divided into Descriptive Analytics, Predictive Analytics, and Prescriptive Analytics [1].

Descriptive Analytics is the basic data analysis technique in which past data are mechanically studied in order to learn the impact of past behaviors on future achievements, and thus anticipate future events. Management reports can be considered a representative example of Descriptive Analytics, given that they seek the clues that link different variables of past events that should be considered for achieving specific objectives in the future.

Predictive Analytics is the technique used for detecting in advance certain events or risk factors likely to occur in the future, and analyzing counterstrategies. It is applied in a variety of statistical techniques, such as machine learning, data mining, and game theory. In predictive analytics, numerical data that represents past transactions are generally used in order to capture significant relationships among various algorithms, statistical models, and patterns not contained in the collected data. It is one of the most widely used analytic techniques in processing big data, and it is essential to secure various analysis tools and a large amount of data to achieve high-accuracy and

high-quality outcomes. In the field of financial services, predictive analytics is primarily used for customer credit rating.

Prescriptive Analytics is a brand-new analytic technique designed to predict the impact of a decision before implementing it. It aims not only at predicting the when and what of an event, but also at analyzing the why it occurs, and thus providing recommendations for optimized actions. From this strategic perspective, the goal of enhancing research competitiveness can also be interpreted as a business analytic perspective from which future actions should be predicted based on numerical data, given that the goal is analyzed based on numerical data, such as historical and changing trends regarding researchers and related technologies.

The business solutions from IBM and AYATA are representative examples of prescriptive analytics. AYATA is the worldwide unique company that analyzes data using prescriptive analytics. Mathematical sciences, machine learning, and computer science are some of the disciplines involved in the analytic techniques used by this company. Despite the great potential and promise that prescriptive analytics holds, organizations using prescriptive analytics account for only 3 % of all organizations worldwide, with the rest still using exclusively structured data.

3 Marketing Scenario Planning

Marketing scenario is a marketing tool that contains detailed and concrete plans for implementing intended strategic measures, e.g., to enlarge ongoing business projects or promote new products and services to potential customers via various media channels prior to launching. Given that business actions and ensuing results depend on the implementation of the marketing scenario, it necessarily occupies an important place in the phase of marketing goal setting. In particular, the scenario planning for small enterprises is of vital importance because of the great impact of the individual business components on the management environment. Nevertheless, the lack of data usable for small business owners poses difficulties in developing strategic plans for them.

When proposing marketing scenarios to small business owners, merely analyzing sales data and providing the results is not sufficient for helping them make proper decisions. In order to efficiently support small business owners, not only structured data that consists of sales and logistical data should be analyzed, but also unstructured data, such as Internet citizen (netizen) social networking service (SNS) feeds that represent consumer responses. Such integrated data analysis with regards to sales, logistics, and level of foot traffic can be applied for making customized sales predictions according to specific days of the week, time of day, age bracket, and gender.

In addition, SNS provides information on consumer responses to individual POS, and the trends of related business lines. By performing integrated analyses of such structured and unstructured data, marketing scenarios that reflect the current situations of small enterprises can be established, and finally, optimized marketing scenarios with the highest anticipated sales figures can be proposed. Small enterprises can thus be supported in marketing-related decision-making in the manner explained in the last part of the Introduction section.

The marketing scenario planning proposed in this paper to support decision makers of small enterprises can be divided into three stages. In the first stage, situation analysis, sales data from the POS under investigation are analyzed. The results provide managers and business owners with an overview of the sales trends and types in POS from multiple perspectives—for example, the types of customer clusters that bought what, when, and how. In the second stage, marketing goals are set, including target customer clusters and access strategies, in order to boost sales. In this goal setting stage, several goals can be considered, and correspondingly, many marketing approaches, such as a simple linear increase in sales at a specific rate or targeting a specific customer cluster. The third stage concerns deriving strategies for reaching the goals set in the previous stage by performing multi-dimensional analysis of various structured data, such as current management situations, foot traffic, and logistical data. The ultimate aim of this stage is to propose the optimal scenario that ensures accomplishment of the sales target or other specific goals.

In line with this aim, we designed a scenario proposal system for small business owners from the angles described above. Figure 1 shows the overview of the system architecture. The system consists of three modules: (1) data collection module in which multi-source structured and unstructured data are collected and converted to analysis-enabled formats; (2) prediction module in which various business models are derived from the data outputted from the data collection module; (3) prescriptive analytics module in which marketing strategies are designed and developed based on the prediction data outputted from the prediction module. In the data collection module, various types of data are collected from multiple sources (providers), processed in the pre-defined forms, and converted to data usable in the prediction module. In the prediction module, the incoming data from the data collection module are analyzed based on various business mind analysis techniques under aspects of product type, consumer types, and temporal elements, such as day of the week and time of day, and their correlations are established and predicted. In the prescriptive analytics module, based on the predicted data, a business scenario is derived that can be implemented in current business situations.

Figure 2 shows an example of a marketing scenario yielded by implementing the prescriptive analytics that reflect the business situations and goals in the last stage of Fig. 1. The result of prescriptive analytics can be largely divided into three parts: (i) anticipated future profit (in graph) shows the current prediction and profit increase rate as a result of implementing the marketing plan by business action; (ii) suggestions of various business actions to take in order to reach the sales target, including the period and manner of their implementation; (iii) numerical information related to the accomplished targets of various business actions integrated in the scenario.

In relation to the suggestions of various business actions, an endless number of combinations may be generated because of the discrepancies between baseline situations of business owners or managers, and POS and management objectives. Storing all these analysis results is a great challenge for conventional relational DBMS (RDBMS) models. This problem is addressed by constructing prescriptive analytics in business prediction models that consider only the elements and factors related to target accomplishment.

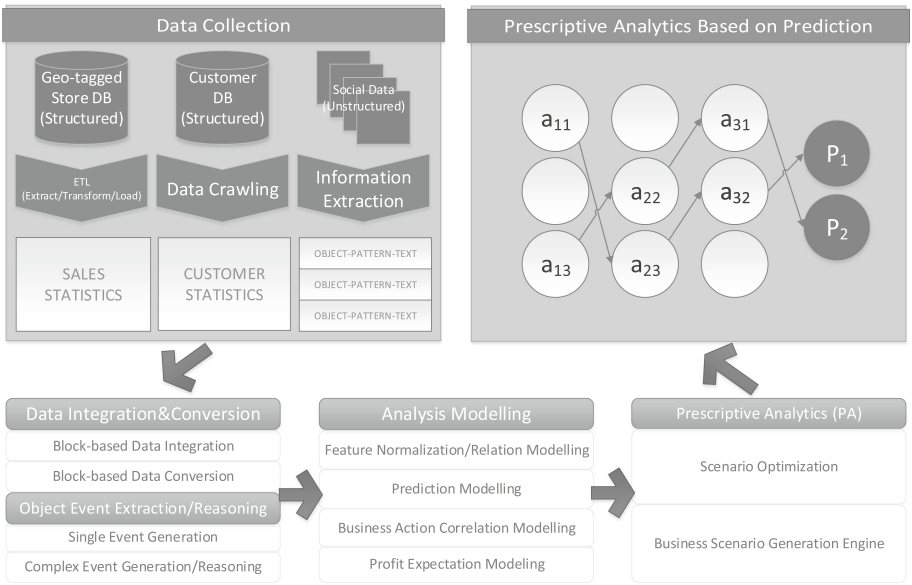

Fig. 1. System architecture for marketing scenario generation

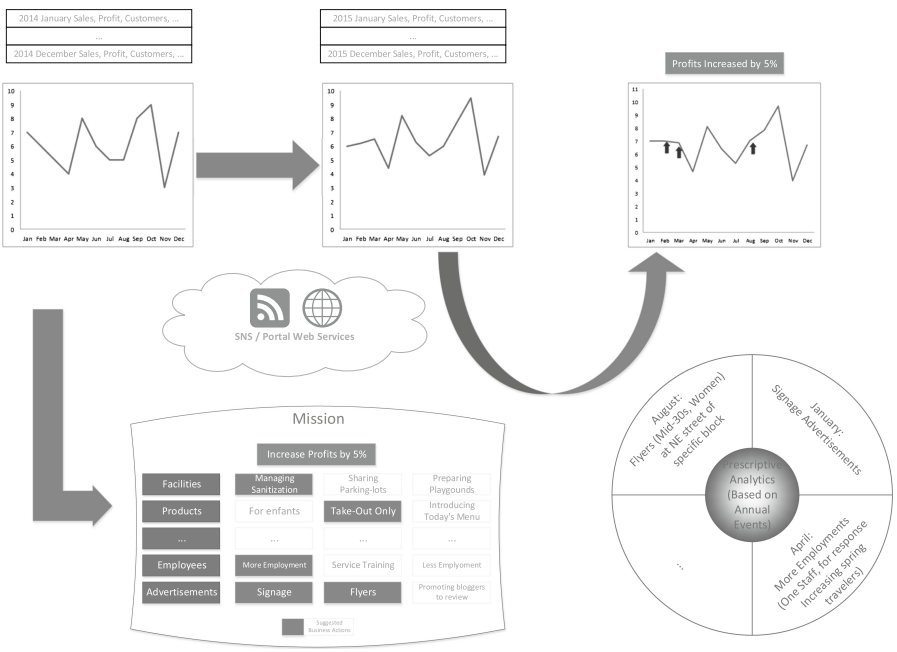

Fig. 2. Conceptual diagram of scenario planning

The proposed system for the marketing scenario design is differentiated from conventional business strategic analysis systems that propose various scenarios in that our system provides an optimized marketing scenario tailored to each management environment in order to efficiently support managers and business owners in decision-making to achieve their sales targets and management objectives.

4 System Architecture

Figure 3 presents the system architecture constructed based on the aforementioned marketing scenario planning system designed to render it practicable in real business settings. Given that the proposed system considers structured and unstructured high-volume business data, it is constructed with the Apache Hadoop system as the underlying system. The major components of Hadoop are Job/Task Tracker that performs distributed/parallel data processing, and Hadoop Distributed File System (HDFS) that stores big data safely and efficiently. On the stable Hadoop infrastructure, high-volume business data are computed with various anticipated-sales models, and Apache HBase Not Only SQL (NoSQL) DBMS infrastructure is installed to support the table schema that facilitates data analysis. By employing the Hadoop HDFS architecture, this infrastructure supports the parallel database processing that could not be implemented in conventional RDB, and adopts a distributed data storage approach for safe data storage. Thus, the data stores can be utilized by the client side for sales prediction through RESTful API supported by default in the HBase infrastructure.

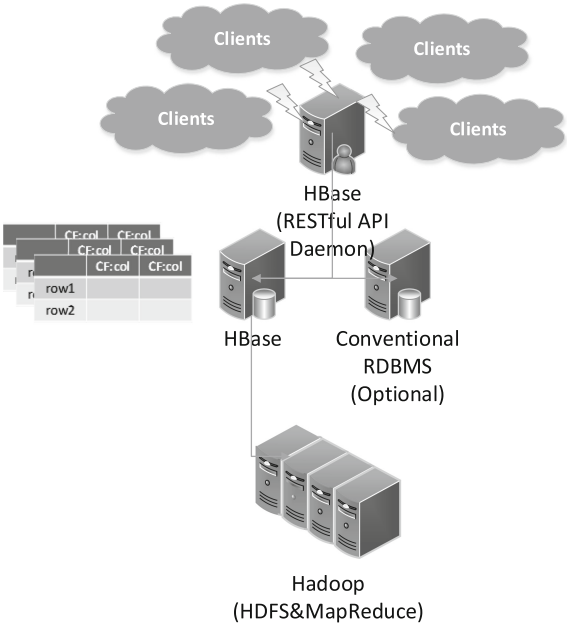

Fig. 3. Hadoop eco-system based architecture of marketing scenario planning system

RESTful API can receive data in the form of a simple ATTP protocol without the need for complicated wiring through the DB query GET/POST method similar to SQL. In particular, the RESTful interface can receive output data in the XML format, which does not require data parsing processes to render the incoming data usable by the client, and it has unlimited capacity for application and expansion without regard to client type.

Business big data have extremely variegated elements, and correcting the schema at each data input, as is the case with conventional RDB, is too complicated and time-consuming. HBase allows for unlimited column input pertaining to various elements once a column family is constituted by gathering the corresponding conceptual columns; furthermore, column family data are expandable, similar to the conventional RDB, via additional operation. The key advantage of the column family system is its simultaneous management of a set of different attributes, which allows the data analysis system architect and client developer to intuitively manage the data. Furthermore, in HBase, the challenge of managing records whose volumes range from millions to hundreds of billions of cases is efficiently addressed by distributed database storage of each node.

Figure 4 presents a design example of a client that suggests a final marketing scenario to a business owner using prescriptive analytics, as described above. A client can be basically divided into two parts: business operation and scenario analyses. In the business operation analysis, a detailed analysis is performed concerning the composition of POS and foot traffic volume according to gender and age distributions, as well as by time and weekday. In the scenario analysis, plausible scenarios that reflect the current sales situation, target sales volume, and the optimal scenario are generated. To facilitate decision-making, a ranking can be assigned to each suggested scenario, and the target achievement rate of the selected scenario can be viewed at one glance.

Fig. 4. Web based system UI providing trading area analysis and recommended scenarios

5 Conclusion

This paper presented a marketing scenario planning system that adopts prescriptive analytics on business big data in order to support business-related decision-making for managers or owners of small and medium-sized entrepreneurs. This system is constituted with the Hadoop/HBase-based data infrastructure capable of big data processing, and therefore multi-tiered business action recommendation could be established as a result of integrating structured and unstructured big data, such as sales, logistical information, and SNS feeds on top of various sales prediction models. At the end, it suggests a group of candidate marketing strategies expected to improve the current sales performance when the decision makers follow the business actions automatically recommended by the marketing scenario planning system.. As further research, we consider conducting a performance test of the proposed approach by evaluating the prediction accuracy of the marketing scenario suggested by the system, and by comparing its efficiency with that of previous methodologies in processing unstructured and/or structured business big data.

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