

Data Mining System in the Service Industry: Delphi Study

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Abstract The use of technology is increasing within the service industry, but there is some doubt as to whether the benefits of employing this technology have been efficiently harnessed such as data mining. Data mining is the process of extracting certain predictive information from databases that can evolve from currently used restaurant management systems. The potential of harnessing this predictive information can have an enormous impact on the restaurant's operation on the whole, particularly in the area customer retention and competition. Since there is insufficient literature on the use of data mining in the restaurant industry, this study is both seminal and investigative, done via a Delphi survey to explore and describe the current and future applications of this process.

Key Words : Data Mining Process, Delphi Study

1. Introduction

National Restaurants Association [11] stated competition is dramatically increasing in the restaurant industry. Carl Dill as cited by Dragoon [5] noted that restaurant units have been growing 5% a year since 1994 while the population of the United States of America only grew by 1% between 1996 and 1997. It is this disparity in growth that he attributed the ferocity of competition in the restaurant industry. Indeed, the dining patron has numerous choices of fares and dining experiences when the decision is made to eat outside the home. How then, can restaurants position themselves to be among the choice set of the dining patron and at the same time be able to evaluate the future sales of the operation?

Technology may provide the answer to this question with the development of digital dining. Menusoft Systems Corporation [10] defined digital dining as a completely integrated restaurant management system (RMS) that is comprised of point-of-sale (POS) programs that include home delivery and a multi-plan frequent diner program. The software includes report generators that archive history files for any period of time. The major components of this system include table service, pre-checking system, customer database management, counter/quick service, delivery, table management, handheld POS, back office, frequent dining, inventory, gift certificate, electronic mileage system [10].

Digital dining can be seen at many places in the world and compared to other competing technologies, it has become more business-orientated with an emphasis on customer satisfaction. Furthermore, as digital dining is widely used in the industry as an extension of the current technology in use

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today, it would be interesting to determine from an industry viewpoint, how data mining would change the industry. Therefore, the aim of this study is to qualitatively examine the current use of data mining in the restaurant industry and determine trends that associated with its continued use such as whether it will evolve into the new frontier of competition in the restaurant business. As qualitative assessment tools, a Delphi study and personal interview to explore data mining.

2. Background Literature

2.1 Technology In the Restaurant Industry

Computer Sciences Corporation [3] completed the Annual Restaurant Industry Technology study that showed a changing attitude toward technology in the industry. A key finding of the survey showed that restaurateurs consider technology to be a tool executives must be able to make money with it. Most restaurant executives already know technology is aligning with business strategy and they are preparing a business case for large technology investments. Technology is very useful for providing the necessary information, but most of the executives do not have clear idea how to use technology for restaurant business. Literature on technology use in restaurant industry is limited as Dragoon [5] noted, and that the industry has been slow to embrace technology. However, she stated that this is changing in view of competition and the lower cost associated with acquiring information technology that now has become the major tool used to position the restaurant ahead of competitors, particularly since information technology cost is decreasing. Stackpole [17] highlighted the case of an almost bankrupt Californian Italian restaurant

chain with 13 units that was able to turn its operation around by using data mining which revealed the demographic makeup, preferences among patrons and their economic status. The analysis showed that the chain's patrons were far more affluent than it had assumed. The restaurant then embarked on a strategy to fine-tune everything from its menu selection and wine list to its atmosphere, all in an effort to appeal to a more discerning and profitable clientele. It should be noted that this turnaround mentioned by Stackpole [17] was only possible through data mining which is the result of the increased use of mobile terminals in the industry. Baek & Hong [2] observed that as the demand for mobile terminals increases, electronic commerce (E-Commerce) is being transformed into mobile commerce (M-Commerce). Businesses are using mobile terminals, such as personal digital assistants, to facilitate the interfacing and eventual integration of M-commerce with the in-house computerized management system.

2.2 Data Mining

Data mining is the automated extraction of hidden predictive information from databases that allows users to analyze large databases to solve business decision problems [19]. The data mining software would use this historical information to build a model of customer behavior that could be used to predict which customers would be likely to respond to the new product. Saarevirta [15] explained that customer clustering and segmentation are two of the most important data mining methodologies used in marketing and customer-relationship management. He continued that the technology uses customer-purchase transaction data to track buying behavior and create strategic business initiatives which can be used by businesses to divide customers into segments

based on such shareholder value variables as current customer profitability, some measure of risk, a measure of the lifetime value of a customer, and retention probability.

The Two Crows Corporation [20] acknowledged that the data mining process uses a variety of data analysis tools to discover patterns and relationships in data that may be used to make valid predictions. Furthermore, Magnini et al [9] data stated that data mining is a largely automated process that uses statistical analyses to sift through massive data sets to detect useful, non-obvious, and previously unknown patterns or data trends. They have outlined the parameters of how this process should be achieved; 1) Match information technology properties with an appropriate provider, 2) build segmentation and predictive models, 3) collect data to support the models, 4) Select the appropriate tools for analysis and prediction, 5) demand timely output, 6) refine the process, and 7) hire a well-trained staff and a knowledgeable IT manager. Also, they indicated several limitations of data mining; 1) data mining analyzes only data collected from existing customers, 2) databases used in the mining process are often brand specific, 3) data mining may not segment travelers by psycho graphic traits, and 4) data mining does not provide information about consumers' thought processes.

2.3 Data Mining Applications

Data mining is becoming increasingly common in many sectors. Data mining is used for a variety of purposes in both the private and public sectors. Industries such as banking, insurance, medicine, and retailing commonly use data mining to reduce costs, enhance research, and increase sales.

First, the insurance and banking industries

use data mining applications to detect fraud and assist in risk assessment (e.g., credit scoring) [20]. Using customer data collected over several years, companies can develop models that predict whether a customer is a good credit risk, or whether an accident claim may be fraudulent and should be investigated more closely.

Second, the medical community sometimes uses data mining to help predict the effectiveness of a procedure or medicine [20]. Pharmaceutical firms use data mining of chemical compounds and genetic material to help guide research on new treatments for diseases. [20]. Stühlinger et al. [18] showed that intelligent data mining in addition to conventional analyses and statistical studies in patient data can deliver further evidence for medical quality management. Han [6] analyzed that how data mining can help bio-medical data analysis and outline some research problems that may motivate the further developments of data mining tools for bio-data analysis. In computer science filed, there is also recent progress in data mining research.

Third, Seifert [16] stated that, in the public sector, data mining applications initially are used as a means to detect fraud and waste, but have grown to also be used for purposes such as measuring and improving program performance. He specifically mentioned Terrorism Information Awareness (TIA) Program and Computer-Assisted Passenger Prescreening System (CAPPS II). Those two programs were represented a direct response to the September 11, 2001, terrorist attacks. Those programs would have sent information provided by the passenger in the passengers name record (PNR), including full name, address, phone number, and date of birth, to commercial data providers for comparison to authenticate the identity of the passenger.

The commercial data provider would have then transmitted a numerical score back to TSA indicating a particular risk level.

Fourth, United States General Accounting Office [21] stated that federal agencies are using data mining for a variety of purposes, ranging from improving service or performance to analyzing and detecting terrorist patterns and activities. Their survey of 128 federal departments and agencies on their use of data mining shows that 52 agencies are using or are planning to use data mining. These departments and agencies reported 199 data mining efforts, of which 68 are planned and 131 are operational. Kusiak et al [7] stated that the research of the future will likely be data driven.

Last, although the use of technology is increasing in the restaurant industry, two interesting points become apparent. Restaurant professionals agree that there is a need for using technology in their business and have invested heavily in implementing it. However it was found that 67% of restaurant professionals are not aware of how to use it to improve their businesses. [3]. This fact is also corroborated by the relevant literature as it failed to highlight the extent to which databases that are developed from RMS and mined for predictive consumer behavior. Thus, it is important for a seminal study such as this to call upon the knowledge base of industry experts to suggest the shape and direction that data mining can take when applied to the restaurant industry.

3. Research Methodology

The primary objective of the study is to understand the extent to which data mining is used in the restaurant industry and determine how its use will be used to shape

the industry in the future. This study can be a foundation for providing useful information specific to the restaurant industry with regard to identifying the forms of technology used for data mining, who analyzes the databases, how the information from data mining is used and determine any usage patterns or trends that emerge. Data mining is the process of using customer information previously collected and transforming and using this data to forecast events pertaining to marketing-related purposes for example. Thus, the research questions are as follows: 1) To what extent is data mining currently used in the restaurant industry?, 2) What are the benefits of data mining to the restaurant industry?, and 3) Is data mining being used to its full potential?

For conducting this research, a Delphi Study would be used. Neill [12] cited that the objective of a Delphi study is to facilitate the reliable and creative exploration of ideas or the production of suitable information for decision-making. Neill [12] continued that the Delphi method is based on a structured process for collecting and distilling knowledge from a group of experts by means of a series of questionnaires interspersed with controlled opinion feedback in order to develop themes, needs, directions or predictions about a topic. Also, qualitative and/or quantitative questions can be asked of the 'experts' and the information is then analyzed and fed back to each person, via further questions, and their responses are analyzed and fed back, and so on, until the goal is reached, that is when a consensus is reached which offers synthesis and clarity on the question. In conclusion, the goal of the Delphi process is to systematically facilitate the communication that takes place via several stages of the researcher asking questions, undertaking analysis, and providing feedback [12].

The Delphi method is an invaluable tool that has been widely used to generate forecasts in technology, education, and other fields [12]. From the results of the Delphi survey, it would be possible to better understand the trends and rank them in order of importance regarding the future use of technology that would be helpful in answering the research questions. It may also be possible to examine the possible usage of database for restaurant business. Therefore the process of undertaking this study involved 1) to review and analyze contents of recent foresight studies conducted in restaurant business and 2) Perform a Delphi study based on this background. Table 1 explains the processes of Delphi study.

Table 1. Processes of Delphi Study

| | Processes |
|-----------|--|
| Round 1 | <ol style="list-style-type: none"> 1. Provide the restaurant managers the round 1 questionnaires 2. Receive completed questionnaires 3. Do simple analysis based on ranges and medians of the respondents |
| Round 2 | <ol style="list-style-type: none"> 1. Provide participants the round 2 questionnaires 2. Do a simple analysis of perceptions and identify patterns in responses |
| Interview | <ol style="list-style-type: none"> 1. Probe deeper into the information presented 2. Identify common themes 3. Issue final report |

For this study, upper level management and restaurant managers were selected as experts in the field. It was intended to have included 30 participants for this Delphi study. As a result 110 e-mails were dispatched to major restaurant chains and from this, 47 replies were obtained. Among these 47 replies, 20 were positive.

4. Results

This study sought to identify the extent of use of data mining in the restaurant industry, its benefits to the industry and determine whether it is being used to its full potential. To accomplish this objective, the Delphi and in depth interview techniques were used to uncover as much information as possible into this particular application of technology in the restaurant industry via group's consensus.

4.1 Description Of The Participants

The 83% of survey participants were generally young professionals between the ages of 31 and 35 years old with Bachelor's Degrees and have worked with their companies between 0 to 3 years. The remaining 17% were older; between 46 and 50 years old who possessed a High School Diploma and Technical Certification and worked with the company for more than 4 years. All of the participants were employed in upper level management positions and 66% were male while 34% were female.

Second, all the participants revealed that they have had previous experience with data mining and the system is currently being used in their restaurant companies. It was found that the 83% of respondents indicated that they were employed for about 3 years and that data mining systems were implemented during this time. Only 17% of the respondents worked for more than four years in the business. The respondents reported that customer relation management was the major reason why the system was introduced. Other reasons included forecasting, marketing and exploring data relationships (within unit and with other units in the chain). In regard to the decision to obtain a data mining system, it was discovered that

generally it is an upper management decision. Only one of the responses indicated that it was a decision that was mutually agreed on by both employees and upper level management. It was no surprise that when asked about the employees' response to the implementation of the data mining system, they were "positive, but somewhat reluctant" for all those respondents who stated that it was entirely an upper management decision while the response was "enthusiastic" when the decision for the implementation was arrived at through consultation between upper level management and staff.

Third, this area proved to be a very sensitive topic for the respondents and was deemed by 50% of them as "proprietary information". From those who responded, Ghost Miner, Space Net and Crystal Reports were the data mining systems they were using. 50% reported that the data mining system that is being used was compatible with the restaurant management system used at the time of its implementation. When asked about whether it the data mining system was compatible with the restaurant management system, 66% responded positively, 17% negatively and 16% did not know. For the most part, 83% of the respondents stated that the process of harnessing the information from the data mining system was actually done in house with 17% using a contracted external management information systems support company.

4.2 Benefits of Data Mining

According to restaurant professionals, data mining has been tremendously helpful to the restaurant business particularly in the realm, but not limited to sales and marketing, customer relationship management, competition and strategic management.

First, the in depth interview was able to determine that accelerating sales growth and improving the brand & reputation of the restaurant were considered as very important benefits of data mining. The system was able to yield information regarding the needs of customers. Restaurant companies were therefore better able to understand and satisfy the needs of the customers. Understanding customer profile has helped the restaurant companies to design marketing programs that target customers with distinctive purchasing behavior's specifically rather than using a blanket approach to advertising which minimizes the impact of the message being communicated. Marketing strategies are therefore carefully crafted and executed as a result of data mining.

Second, customer relationship management was the area that emerged as the greatest benefit of data mining. Therefore it was decided to investigate this area more profoundly to uncover the elements of customer relationship management that lead to its importance among survey participants. Noting trends in consumer behavior and determining customer satisfaction were only incrementally more important than the previously mentioned. This was indeed confounding as generally, these factors taken together should all be important to impact positively on customer relationship management.

Third, another benefit of data mining is the ability to detect operational deficiencies or negative trends that would allow for proactive measures to be taken to correct it before they can affect the business. Similarly, positive trends have also been identified which enabled management to put the necessary systems in place to capitalize on an emerging trend before its competitors. Information from the system is also harnessed which allowed the company to check on any

variance from the established goals of the chain or unit. Change occurs rapidly in the restaurant industry and the data mining system has helped restaurant companies to identify changes in their environment and develop strategies in a timelier manner to deal with it.

Fourth, the data mining system has enabled restaurants to become fiercer competitors in the market place. Many restaurant companies are aware of value of customer relationship management and using technology which has "sharpened the weapons of competition" (as one respondent said) such as advertising, pricing and customer satisfaction. Therefore, to most restaurant companies, data mining has helped redefine their competitive methods in order to constantly meet and exceed the needs of their clientele. The feedback that companies receive from data mining has also help companies to evaluate its competitive strategy and make corrections when needed. Furthermore, the secondary dimensions of competition that data mining was able to improve were in the areas of sales forecasting, customer satisfaction and the ability of the company to move ahead more rapidly with changes.

Last, information that the data mining system provides included their perceptions of the product and service of the restaurant such as the overall service received from employees, food taste, food variety, friendliness, cleanliness and efficiency. The consensus of the restaurant professionals here was that the data mining system was able to determine emerging trends. Purchasing patterns are derived from data mining and thus restaurant companies have an insight into the likes and dislikes of customers. It was particularly helpful in determining whether customer preferences have change or not and to identify the areas of change. Data mining is

capable of significantly increase customer revisit because it is also able to increase customer retention and loyalty rates. These outcomes of data mining appear to share a very strong correlation.

4.3 Assessment of the Use of Data Mining

Based on the responses in regard to how data mining is used by restaurant companies, all agreed that it was used to improve customer relation management as to its major purpose. Improving operational efficiency and refining menu options were secondary purposes of the data mining systems. There was a unanimous agreement by the respondents that they believed that the data mining systems that the company uses should yield more benefits and that restaurant will continue to rely on technology in the future. These benefits as they indicated were to 1) be able to differentiate its market, 2) help with event marketing, 3) help with electronic marketing and promotions, 4) determine peak demand periods and 5) meeting and exceeding customer expectations. 83% believed that their companies were using data mining effectively while 17% did not believe that they were using it effectively.

Seven benefits emerged as being a source of help to the overall operations of the restaurant chains. It was important for this study to investigate the extent of consensus regarding these areas in order to determine whether there were trends emerging.

5. Conclusions

The advent of data mining in the restaurant industry which has occurred in a large part in the last three years, appear to be aligned with previous research that

suggested that the industry will continue to rely on technology in the future. In evaluating how the technology is used in the industry, there seems to be room to broaden the use of this application in terms of the type of data is placed in these databases and the increased predictive information that could be harnessed from the system. Based on the results of this study, some conclusions are provided.

First, customer relationship management was viewed as an extremely important benefit of data mining although it appeared that understanding and relating to customers better, trends in customer behavior and customer satisfaction were the major influences that brought about this benefit. In observing level of consensus regarding the positive impacts of data mining on the restaurant company, there was a large degree of consensus among participants in regard to the most important benefit of the system being its assistance in improving customer relationship management and formulating the strategic plan of the restaurant. Improving competition, and accelerating the sales growth were ranked second and third respectively.

Second, competition was seen as a benefit of data mining on account of the timely analysis of large amounts of data which were able to detect trends in buying behavior relative to the age of the customer. However, there appeared to be an industry wide reliance on traditional market research methods that were perhaps used to corroborate information from both sources prior to refining the competitive edge of the company. Also, the use of data mining will continue in the restaurant industry but it is expected to yield greater utility to its users in the future when the important methodologies of customer clustering and segmentation are incorporated in the overall system.

Third, from the restaurants surveyed,

database marketing is not done. This is an important and cost effective activity which many other industries such as retail, that communicates with their target market about special sales promotion events or merely contact them to wish them well on occasions such as birthdays, anniversaries, or the holidays to name a few. Considering the rapid growth of the restaurant industry and the extreme nature of competition, more must be done to establish more personal ties with the restaurants clientele.

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