PERGAMON

Expert Systems with Applications 21 (2001) 37–51

Expert Systems with Applications

www.elsevier.com/locate/eswa

A study on time series pattern extraction and processing for competitive intelligence support

Soe-Tsyr Yuan*, Ming-Zeng Huang

Information Management Department, Fu-Jen University, 510 Chung-Cheng Road, Hsin-Chuang, Taipei 24205, Taiwan

Accepted 27 February 2001

Abstract

In the era of rapid growth and high competition, a company must possess an information/knowledge advantage in order to hold the upper hand in the industry. Therefore, the company has to continuously monitor its competitors in order to get enough information and convert the information into competitive knowledge. Although information technology has been used in many areas and has many successful examples, it is rarely the case that information technology was used for the task of competitor intelligence. Accordingly, this study devises a method of time series pattern extraction and processing for the task of obtaining place-prospect competitor intelligence in order to advance an enterprise with a competitive knowledge advantage. The purposes of the method are two-fold: (1) For a product manufactured by the company, the gathered data are mined into a knowledge advantage—an appropriate amount of the stock to be allocated at a timely fashion at a retailer in face of competition. (2) This knowledge advantage alerts the company's decision makers to what is unknown and forces them to make good decisions on the stock allocation problem, freeing them from the dilemma of over-stock or under-stock with respect to competitors' stock. Our approach differs from traditional inventory management in the grounds they are based: traditional inventory management is based on the perspective of cash flow while our approach is based on the perspective of competition encountered. The results show our method is quite promising to this end, obtaining the intelligence to gain competitive advantage.

Keywords: Competitive intelligence; Time series pattern extraction

1. Introduction

It is a fairly accepted fact that competition will become even more intense in the 21st century compared to what it is today. As we move forward from the Information Age to the Intelligence Age, success will come to those companies that develop and maintain their competitive intelligence (CI) (see Competitor Analysis—a Brief Guide, hhtp://dspace.dial.pipex.com/aware/competitor-analysis.html; Information on your competitors, hhtp://www.competitive-intelligence.co.uk/; Marketing Plan Components: Competitor and Issues Analysis, hhtp://www.onlinewbc.org/docs/marlet/mk_mplan_competitor.html).

CI is the process of obtaining vital information on your markets and competitors, analyzing the data and using this knowledge to formulate strategies to gain competitive advantage (Fayyad, Piatetsky-Shapiro & Smyth, 1996; Tyson, 1995). *This competitive advantage can be shown in different respects such as product, price, place, and promotion* (*4P in Marketing Management*). CI alerts you to what is unknown and forces you to make good decisions. This is different from market research which supports decisions that have already been made and mainly utilizes surveys or questionnaires for the understanding of the results of the strategic directions of their companies.

The rationale behind why CI is valuable to decision makers is described as follows (Tyson, 1995): (1) to maintain market share in the face of strong competition; (2) to identify opportunities for growth; and (3) to minimize threats. Key decision makers search for intelligence because it is information that can be acted on, resulting in a profoundly good effect on a company's market position and profitability.

In the past, companies relied heavily on CI professionals to help decision makers understand their market position and opportunities. However, human professionals have their limitations on the amount of information they can gather and analyze and the precision of the results they can obtain. To this end, *in this paper, for a particular real problem, a novel method of competitive intelligence support* (*CIMiner*) *is presented and evaluated, showing to the CI professionals its values mentioned above*.

* Corresponding author. Tel.: +886-2-2369-3220; fax: +886-2-2369-3220.

E-mail address: yuans@tpts1.seed.net.tw (S.-T. Yuan).

0957-4174/01/$ - see front matter
PII: S0957-4174(01)00025-2

The following is a description of the particular real problem this study is trying to conquer.

- For a given company (a worldwide leading printer company) that manufactures a set of products such as laser printers and ink-jet printers, it has numerous contracted retailers each of which is located at different place. For each of the products, at a specific time, each retailer has a particular amount of the product in stock (*Stock*) and a particular amount of the product sold (*Sale*). However, the retailer may also involve the retail of a similar product manufactured by a major competitor of the company and hence has a particular amount of this similar product in stock (*C-Stock*) and a particular amount of the similar product sold (*C-Sale*).
- The goal of CIMiner is to continuously provide intelligence for the decision makers of the company to act on for resulting in a good effect on a company's market position and profitability in face of a major competitor's threats.
- This intelligence is that for each product and retailer, *a suitable amount of the product that should be placed at a right time so that Stock can be in accord with Sale, and such an accordance/suitability depends on the major competitor*. In other words, this study aims to provide a *place-prospect competitive intelligence support system*, with which the company may rationally places its products at retailers to the benefits of the company in the long run.
- The benefits can be described in three-fold. (1) Minimize the cost of unnecessary holding inventory at the retailers (i.e. the situation as shown in Fig. 1(a) in which a great amount of inventory cost incurs when *Stock* overwhelms *Sale*). (2) Minimize chances of losing possible sales (i.e. the situation as shown in Fig. 1(b) in which there will be opportunity loss when *Sale* overwhelms *Stock*). (3) Maximize chances of having profits (i.e. the situation as shown in Fig. 1(c) in which there will be no unnecessary cost holding and no opportunity loss when *Sale* is in accord with *Stock*).

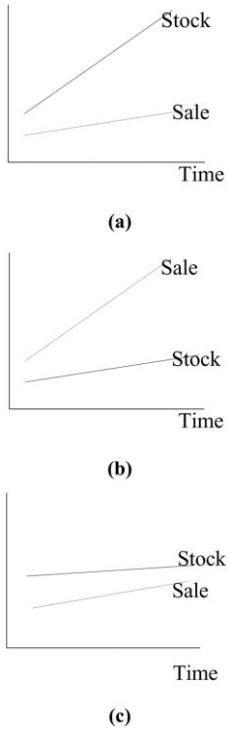

Fig. 1. The relations between Stock and Sale: (a) overstock (b) opportunity loss (c) accordant.

The difference between our problem and traditional inventory problems is described as follows.

1. Traditional inventory problems mainly concern about the amount of merchandise, parts, supplies, or other goods a business keeps on hand to meet the demands of its customers from the perspective of cash flow (Schreibfeder, 2000; and see Turnover Analysis, hhtp://www.advantageasessment/com/bibrary/TurnoverCost.htm). Depending on the nature of the business (i.e. retail, wholesale, service, manufacturing), the efficiency of inventory management may have a significant impact on the cash flow and, ultimately, the business's success or failure. For example, from a cash flow perspective, turnover analysis (see Turnover Analysis, hhtp://www.advantageasessment/com/bibrary/TurnoverCost.htm) was used for finding inventory items that are excessive, too low, or just right. (An excessive investment in inventory results in less cash available for other cash outflow purposes, such as paying bills.)
2. The problem addressed in this paper concerns the amount of a product required at a time at a retailer for a business of a printer manufacture from the perspective of competition encountered. That is, the information of the markets and the competitors is analyzed for obtaining the knowledge, which is unknown but good for decision making to gain competitive advantage.[1]

The method of the CIMiner is a combination of time series pattern extraction and time series pattern processing. The basis for the choice of this time-series-based approach is two-fold. (1) The amount of a product required at a retailer is time dependent. That is, suitable amount of the product that should be placed at a retailer may vary at different time in order to have Stock in accord with Sale all the time. (2) A natural way to come up with a time-dependent solution of the amount of the product required is using time-series-based approaches, which have been used to study patterns in

[1] Inventory management from both the perspective of cash flow and the perspective of competition encountered is worthy of future research.