



A mobile knowledge management decision support system for automatically conducting an electronic business

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ABSTRACT

This paper presents a mobile knowledge management decision support system using multi-agent technology for automatically providing efficient solutions for decision making and managing an electronic business. The architecture consists of a user interface, an assignment agent, a knowledge reasoning agent, a search agent, a knowledge base, a database, and a model base. The knowledge reasoning agent selects appropriate rules from the knowledge base and uses the facts in the database to reason out suitable solutions, which match better effectiveness via a forward chaining reasoning method. Furthermore, to provide instant management and control, we have developed an automatic agent to manually or periodically monitor managerial problems using knowledge rules. In addition, the system makes use of ASP combined with Visual Basic to build the functions so that the system is easily implemented. We have also designed a user transparency approach to modify all vital rules, if necessary, without revising the program source codes, so that users can easily manage the knowledge base. Users can modify, add, or drop their latest knowledge rules from the system. When new knowledge is introduced, the system is able to automatically evaluate accurate actions or alternatives for conducting an electronic business. Finally, for the purpose of improving financial management, a neural network is used for predicting future financial measures.

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1. Introduction

The rapid growth of wireless networks, smart phones, and personal digital assistants during the last decade laid the foundation for mobile management. Many modern cities around the world have built, or are planning to build, city-wide wireless networks so that citizens can use a notebook or personal digital assistant to access information anywhere within the city. Furthermore, with the tremendous progress of information technology, knowledge management becomes much easier and effective. Knowledge management can assist in all the practical aspects of running a professional business. However, almost all traditional information systems focus on simple and predefined formulas for managing manufacturing, production, sales, etc. Even e-commerce and m-commerce mainly deal with selling goods or providing services on the web. They lack of the functions of automatic knowledge reasoning and management for running a company. In our study, we concentrate on how to automatically manage and control an electronic business (e-business) using multi-agent skills and knowledge management (e-business means that a company designates the use of Internet and digital technology to execute all of the

activities in the enterprise). Additionally, utilizing knowledge management and knowledge reasoning, we develop a mobile knowledge management decision support system to provide alternatives or suggestions to aid in decision making.

This study is motivated by several considerations. First, the growth in the number of mobile subscribers is expected to surpass the number of fixed subscribers at some point in the near future. Therefore, mobile managers need a powerful mobile device to trace or manage their company. Second, globalization and information technology have altered business management and competitive styles. Nowadays, many companies need to manage and control their organizations in a global marketplace via the Internet, since most businesses face global competition. Sometimes, companies might even need to organize a global work team or adopt a global delivery system. Conventionally, a global company will ask its subordinate organizations scattered across different countries to report their working performance or progress via the Internet. Also, global companies often hold monthly or quarterly meetings to gather all representatives from its overseas branches to discuss current problems and issue directives for the branches to follow. It seems very effective to employ Internet-based technology for transferring information, but the procedures are tedious and costly if there is no Internet-based information system to help process them. Third, many businesses have already built an enterprise sys-

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tem, customer relationship system, or supply chain management system that controls all the activities of the company. However, although these systems generate a large amount of important information, they lack the application of integration from a management point of view. Finally, even in a local business, a top-level manager sometimes holds weekly or monthly meetings to communicate or give management instructions to his subordinates. In such meetings, there is often nothing new to report except for the working progress or performance accomplished in the past week or month. All such data can actually be found in the database produced by ERP, SCM, CRM, or other information systems. Why not to build a decision support system to integrate all critical information and to enable automatic inference of a suitable action or suggestion for the decision maker?

Furthermore, accurate business performance measurement is critical to understanding business success and failure. The increased attention to business performance evaluation by professional managers, consultants and academics shows that companies strive to improve their business performance. Even if the assessment of the performance of a firm is a challenging and complex task, many organizations still are striving to enhance performance for survival and making profits. Some companies employ effective manufacturing management to reduce production cost. Some businesses, through e-commerce or m-commerce, are able to sell their products or offer services directly to customers, bypassing intermediaries such as distributors and retailers. Erasing intermediaries in the distribution channel can reduce transaction costs. Similarly, if we make use of an automatic multi-agent system to help professional managers trace and control an electronic firm, managers can get instant decision-making information via a wireless network. Such a system can save a lot of the time and money required for gathering and analyzing all of the data that is collected and integrated from various information systems.

As for how to measure financial performance, Manley and Tyrant [24,29] introduced four main categories of financial ratios: liquidity, profitability, leverage, and activity/efficiency. They represent powerful information for operating a company when they are used in comparisons with the company itself, with the company's close competitors, and within the industry. Murphy et al. [23] surveyed 124 articles and identified measures related to financial and operational performance. The performance measures were in turn divided into eight dimensions: efficiency, growth, profit, size, liquidity, success/failure, market share, and leverage, with each dimension having its own set of measures. A total of 71 different measures were thus identified. Finally, they summed up the total number of measures that occurred in each article. They found that there were four commonly used types of dimensions for evaluating business performance: efficiency, growth, size, and profit. In the survey, 60% of the surveyed studies only used one or two dimensions. No study in the research used more than five of the eight dimensions. Some studies show that 19% of 52 articles adopt one measure and 71% use four or fewer measures. Other pioneering research related to business performance has been found in Refs. [2,6,7,10,18,25,27]. After organizing the above research, we can roughly classify measures for evaluating performance into two domains as below:

1. *Financial performance.* The financial performance primarily contains efficiency (e.g., return on investment, return on equity, return on assets, return on net worth, etc.), growth (e.g., change in sales), profit (e.g., return on sales, net profit margin, gross profit margin, net profit level, etc.), liquidity (e.g., sales level, cash flow level, current ratio, quick ratio, etc.), leverage, and others. Other measures include long-term capital/fixed assets ratio, circulating ratio in the debt payment aspect, receivable account velocity, duration of account receivable, stock velocity,

fixed assets velocity and total assets velocity in the operating capability aspect, sales growth, profitability (e.g., return on investment, return on sales, return on equity, etc.), earnings per share, overall financial performance, and so forth. Based on the above indicators, enterprise performance can be analyzed and evaluated by financial data for the reference of decision makers.

2. *Non-financial performance.* Non-financial performance mainly contains innovation and stakeholder performance. The measures of innovation performance are composed of R&D outlays, product innovations, and process innovations. The stakeholder performance involves employment growth/stability, employee morale, customer relations, and supplier relations. Certainly, some others will also include in the non-financial performance such as new product introduction, product quality, marketing effectiveness, and manufacturing value-added.

There are many other views and ideas about evaluating and tracking enterprise performance. Venkatraman and Ramanujam [31] claim that non-financial performance indicators (operational performance), such as market share, product quality, R&D capability, manufacture efficiency, customer satisfaction, etc., need to be considered in addition to financial indicators in performance evaluation. Miles and Snow [21] asserts that improved business performance needs an organizational structure, information systems, and management style related to a specific-firm strategy. Ford and Schellenberg [9] summarized three basic frameworks frequently used to form business performance. The first method, the main approach, seeks a definition based on explicit goals or goals that can be implied from the behavior of business's members. The second method, the system resource approach, is to assess business performance according to the key internal and external factors on which the company depends for survival. The last method, the constituency approach, provides a wide range of 'constituencies' for business performance assessment to satisfy constituent needs. Yamin et al. [33] investigated the relationships among generic strategies, competitive advantages and organizational performance under different conditions. They suggested that there were significant differences when different generic strategies were adopted. Using a path analytical model, Hoque [11] surveyed and discussed the impact of strategy and environmental uncertainty on performance using 52 samples of manufacturing. The results showed that a management's strategy choice positively influenced performance. However, there was no evidence showing a relationship between environmental uncertainty and performance. Maiga and Jacobs (2004) examined the relationship between an enterprise's benchmarking and its performance. He found three elements of benchmarking that affected performance positively: prior experience with benchmarking, a commitment of the organization to benchmarking, and an internal preliminary competence analysis. These factors help to improve an enterprise's performance.

Many studies focused on the impact of strategies and competition predominance on enterprise performance. Lebas [13] focused on the relationship between performance management and measurement and found that they were closely related. Common criteria for evaluating enterprise performance include (1) employment creation, (2) social goods, (3) security of employment for the firm's personnel, (4) providing a satisfying return to corporate headquarters, (5) innovativeness in processes and product, (6) customer satisfaction, (7) growth of market share, (8) environmental contribution, and (9) technological leading edge. The enterprise performance covers a wide range of topics.

Many scholars also state that outsourcing affects an enterprise's performance. Murphy et al. [23] assert that accurate performance evaluation is a key to success for enterprises. Their research can be summarized in two points: (1) more than 60% of the studies

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