AN ADAPTIVE DECISION SUPPORT STATION FOR REAL ESTATE PORTFOLIO MANAGEMENT

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ABSTRACT

The paper proposes an adaptive decision station to create real estate portfolios. The decision station would be useful for investors interested in real estate investment and for environments where data needs to be constantly updated by using the internet. The Findlay model was selected for the portfolio management engine of the decision station gives its simplicity and previous results.

A prototype was built based on the proposed model and tested by using real estate data collected from 63 cities from different metropolitan areas in the United States for each quarter from 1999 to 2005. The results showed that the station was able to determine which properties should be selected from a set of input choices in order to minimize risk and maximize return of investment.

Keywords: *Decision Support Systems (DSS), Portfolio Management, Real Estate Investment, Web Based DSS.*

1. INTRODUCTION

A decision support system (DSS) can be described as an interactive, computer-based information system designed to help decision-makers to solve poorly structured problems. Using a combination of models, analytical techniques, and information retrieval, such systems help develop and evaluate appropriate alternatives. Decision support systems should focus on strategic decision, not operational ones. More specifically, they should contribute to reduce the uncertainty faced by managers when they need to make decisions regarding future options.

In the last two decades the finance theory has been applied to the real estate decision making process but with not much effort of the business or academia to develop a decision support that integrates this knowledge, and transmits the theory to real world practice.

Property investors face every day critical decisions as, which properties to buy in order to maximize their return of investment with a moderate or low risk. A decision support system can increase the profitability of the industry since the time of response is the most critical factor in the real estate business.

The scope of this study is to develop a decision support station for real estate investment analysis that will be capable of creating real estate portfolios. The station is based on the decision station model proposed by Vahidov and Kersten [1], this model is ideal for real estate investment applications as it has the capability of directly sensing and acting upon the environment. It involves sensors, effectors, as well as active user interfaces.

Real estate variables are dynamic and time variant [2]. In the real estate market, there are a large amount of transactions happening daily. Historical data behavior can change substantially within a short time period and this can have an impact in the estimated risk and return of a real estate portfolio. Given the dynamic nature of the real estate data, it is important to monitor portfolio performance and make appropriate adjustments in order to keep the portfolio risk low. Figure 1 describes the proposed DSS architecture for this study.

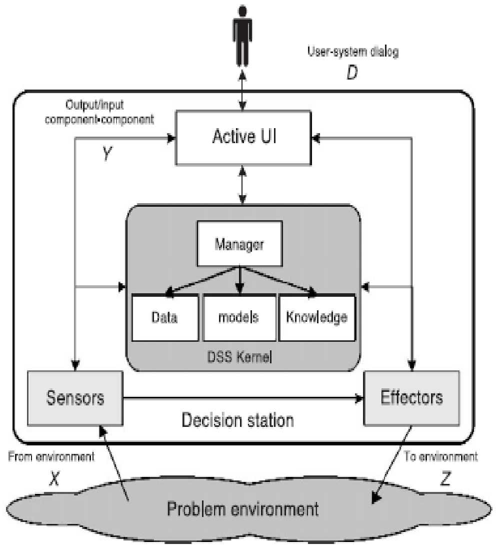

Figure 1 DSS Architecture

The sensors in the proposed real estate decision station can be multiple agents that collect information from different sources. These can be real estate markets, historical information, analysts' opinions, new articles, and other relevant sources.

The effectors execute user investment decisions. Effectors can be linked to various online agents for transactions. They calculate total amounts to be paid, placing special orders using pre-specified rules. They query sensors about current prices to execute special orders [1].

The DSS kernel is composed of DSS models. In the proposed architecture, it incorporates the Findlay portfolio management model for estimating portfolio risk and return [3]. The Findlay model is described in equation 1 and was selected for this study as it was designed to work for real estate portfolios and has been tested before by Grisson, Kuhle and Walther [4], with good results.

$$Z(e)=\min \left[\sum_i \sum_j (X_i C_i \sigma_i \rho_{ij} \sigma_j C_j X_j) / \sum_j (C_j X_j)^2\right] \quad (1)$$

Where

$Z(e)$ = The objective function that calculates the variance of a portfolio of indivisible Assets.

X_i = Either 0 or 1, representing the decision to either invest or not invest in the asset,

C_i = The cost of the ith asset,

C_j = The cost of the jth asset,

σ_i = The standard deviation of the ith asset

σ_j = The standard deviation of the jth asset

ρ_{ij} = The correlation coefficient between assets I and j, and

$C_j X_j$ = The total portfolio outlay

2. DESIGN AND IMPLEMENTATION

The design of the proposed DSS is shown in figure 2. The DSS is composed of problem environment , sensor, effector, DSS Kernel, and user interface.

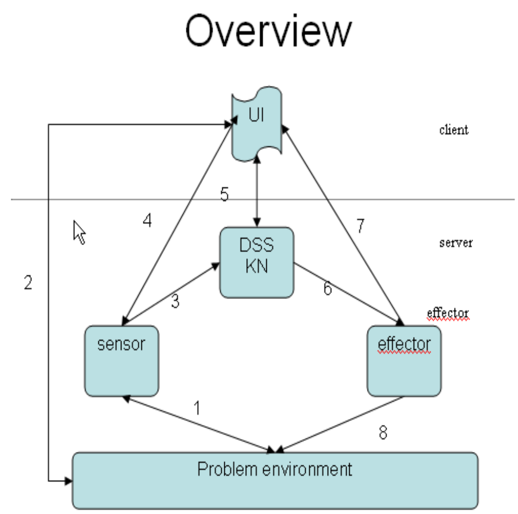

Figure 2 Design of the DSS

The DSS has two key capabilities: (i) the capability to access the state of affairs, and (ii) the capability to change the state of affairs. The former is achieved with sensors and the latter with effectors. Sensors, effectors (together with the kernel), and active user interface comprise the generic DS illustrated in Fig. 2.

The kernel is composed of the DSS facilities in a traditional sense (i.e., database, models, and knowledge base) relevant to a problem domain. It includes an active component: the DSS manager. The manager requires a knowledge base containing, among others, business rules, in order to be capable of performing some of the tasks autonomously.

Sensors capture the data relevant to the problem domain from a variety of sources. The sensors may have more advanced functions as well, i.e., search for relevant sources, filtering and pre-processing of data, alerting generation, and other useful features.

Effectors are the devices used by a decision station to send signals to the problem environment with the purpose of directly altering current state of affairs. Similarly to the sensors, the effectors may engage in different activities required to implement a decision. Implementation-wise, these parts can be integrated into a single module.

Active user interface has been included to signify new ideas and developments in facilitating human–machine dialogues. Such interfaces may incorporate synthetic characters, reside on wearable devices, and have learning capabilities.

To handle time variant issues, the DSS has sensors that can actively gather data from external problem environment and feed it into the decision engine kernel.

3. TESTING AND RESULTS

A DSS prototype was built based on the proposed architecture and design and tested with real estate data collected from 63 cities from different metropolitan areas in the United States for each quarter from 1999 to 2005. The data collected consisted in the return of investment rates for each of the 63 metropolitan areas for a specific investment property type. The property types used were office, retail, apartment building and industrial.

The data was loaded into the DSS prototype and was configured to select the optimal portfolio by minimizing risk. The station was tested by entering 6 sets of 15 investment properties with their sale prices. The summary of the results is presented in table 1.

Table 1. Summary of results

Number of properties Selected	ROI of portfolio	Risk	Total Investment
9	6.5	0.0001	10537800
5	8.56	0.0004	7645900
7	6.47	0.0012	6454400
6	8.98	0.0001	5881650
5	8.36	0.0001	6391000
6	7.75	0.0001	2636674

The decision station selected the real estate investment properties that would allow the investor to minimize risk. The table presents the number of selected investment options from each set of 15 evaluated properties. The DSS was able to minimize the risks of the 6 portfolios generated by providing a ROI of a minimum of 6.47 and a maximum of 8.98. The station is not capable of working on a budget so total investment for each portfolio is different but future versions of the prototype would address this problem.

4. REFERENCES:

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