

Development of a Semantic Multi-Agent Based Intelligent Ethical Wealth Management Planner

D. V. Viswacheda, Patricia Anthony, Rosita Chang, and Chin Kim On

Abstract—In this paper we study the wealth management evolution in developing countries and existing wealth management services. Wealth management is one of the growing industries in developed countries due to the rich economy of the organizations. We present our case study on multi agent based ethical intelligent wealth management planner. We will discuss the various factors of implementation in wealth management and review on how wealth management is implemented technically using semantic multi agent technology.

Index Terms—Wealth management, semantic multi-agents, intelligent ethical wealth management planner.

I. INTRODUCTION

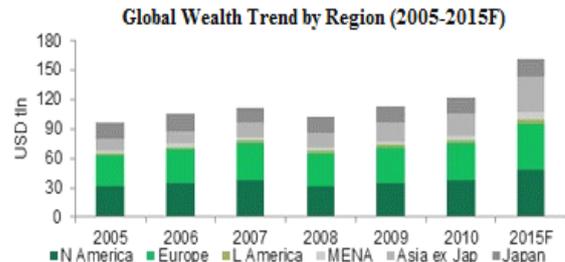
Global wealth is projected to grow by approximately 6% annually between 2011 and 2015 to reach USD161.9tn [1]. The growth in the global economy is projected to continue for several years in the future. This has gradually increased the income and created many wealthy people. The evolution of wealth management started over the past 30-plus years, the business of serving wealthy clients has gone by many monikers, and each time, it shifted and broadened the value delivered to clients. It started out as "personal banking," became "private banking," transformed into "private client services," and finally evolved into "wealth management." [2]. Wealth management is a technical business to be accomplished by skilled fund managers. The success of the wealth management business for any firms depends to a large extent on the ability in acquiring clients and establishing solid and lasting relationship. Wealth management firms should have fund managers who have the capability to manage funds efficiently and relationship managers who have the capability to explain confidently and impressively to clients about investments, asset allocation, diversification and portfolio returns and risk. Today a number of private sector banks, standalone wealth managers, stock broking companies and some public sector banks have entered into this wealth management sector.

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Source: IMF, BCG

Fig. 1. Wealth management investment progress

The reminder of this paper is as follows; in the Section II the definition of wealth management and its purpose is presented. Section III reviews the semantic multi agent technology. In Section IV background and related work is presented. In Section V the architecture of the intelligent ethical wealth management planner is presented followed by conclusions.

Wealth Management is defined as an advanced type of financial planning that provides individuals and even the families with private banking, estate management, investment management, taxation advice, and portfolio management [3]-[4], planning, asset management, legal service resources, trust [5]. Thus, wealth management encompasses asset management, client advisory services, and the distribution of investment products, planning, asset management and legal service resources.

Wealth managers deal in a more complex mix of assets than any other asset manager. Their clients have share holdings, but they may also have bank accounts with the firm and they may wish to borrow money for particular purposes. These three business lines are core to any large wealth manager asset management, banking and credit [6]. Wealth managers are offering increasingly cultured financial planning advice to their clients. The investment made by clients worldwide from 2005 to 2012 is about nearly USD 965 trillion world wide, as shown in Fig. 1 [1]. This may be by means of online offerings of different products with suitable commentary on why a particular product is best for a specific situation or by means of one-on-one sessions with an advisor who has access to a wide range of financial products to meet the complex client needs. Wealth management can be provided by independent financial advisors or large corporate entities whose services are designed to focus on high net worth retail customers. The reason for the ethical term in the wealth management planner is that the wealth that was profited through the transactions are pure and according to the law of the government.

The purpose of wealth management is to

- Build an investment policy for the clients
- Risk factors and their impact on wealth creation and retention
- Standard asset classes including equities, bonds, bullion and deposits
- Alternative investments required by sophisticated investors like derivatives, commodities, real estate and art
- Asset allocation and optimization of portfolios
- Portfolio tracking and rebalancing using agent Technology.

II. SEMANTIC MULTI-AGENT TECHNOLOGY

Semantic technology is defined as the technology that encodes the meanings separately from data and content files, and separately from application code. This enables machines as well as people to understand, share and reason with them at execution time. With semantic technologies, adding, changing and implementing new relationships or interconnecting programs in a different way can be just as simple as changing the external model that these programs share [8]. An agent is a computer system that is accomplished by independent action itself for the purpose to meeting its design goals [9]. When more than one agent interacts with other agents, it is called multi agents. The purpose of using semantic agent technology in this paper is to specifically use the Semantic agent services for describing web services with semantic agent framework so that service discovery, composition and invocation can be done automatically by the use of intelligent agents which are able to process the semantic information retrieved and processed for the specific purposes.

III. BACKGROUND AND RELATED WORK

There are many variations of agent's application in wealth planning such as the work of Dugdale [10] (investment management), Gao [11] (family financial planning and family wealth management) and Jiao [12] (product portfolio planning). The increasing number of wealthy families, large amount of intergeneration transferable wealth, rolling financial markets, constantly changing tax law and increasing complexity of planning transaction increase the demand of aggregated family wealth management (FWM) services. However, current trend of developing such advisory systems is mainly focusing on financial or investment side. In addition, the existing systems are inflexible; they are not autonomous in solving problems, and they do not possess rich interactions, pro-active and reactive features. Gao [11] proposed a novel architecture of web-service-agents-based FWM systems. Agent technology is applied to deal with the complex, dynamic, and distributed FWM processes while web-services techniques are proposed for more interoperability and scalability in network-based business environment. By integrating agent technology with Web-services to make use of the advantages from both, this approach provides a more intelligent, flexible, autonomous, and comprehensive solution to FWM.

The demand for family financial planning (FFP) services is growing dramatically as the financial market grows more complex and people become more aware of the importance of qualified financial guidance. To provide decision support for FFP-related decisions, Gao [11] formulated a conceptual model for FFP by following Dugdale worked on the development of a cooperative Simon's decision-making process model and map the model to the generic FFP process problem-solving system for the domain of investment management [10]. Much of investment management involves comparing alternative solutions. Dugdale utilized an assumption-based truth maintenance system (ATMS), which allows multiple hypothetical scenarios to be modeled. This is the technique used to store each agents portfolio solution, constraints and underlying decisions. Analysis of transcripts obtained during knowledge acquisition revealed seven functions that a cooperative problem-solving system should seek to provide. The resulting system provides a cooperative environment in which multiple users can investigate and compare different solutions, build new approaches to obtaining a solution and introduce new concepts to engender discussion. Frank and Jonnson [13] described Constraint Based Attribute and Interval Planning (CAIP) which is a paradigm for representing and reasoning about plans. The paradigm enables the description of planning domains with time, resources, concurrent activities, mutual exclusions among sets of activities, disjunctive preconditions and conditional effects. In this work it demonstrated how this framework incorporates the use of constraint representation and reasoning technology to improve planning. They implemented a system called the Extensible Universal Remote Operations Planning Architecture (EUROPA) using the CAIP framework. Bajo et al. [14] developed a hybrid architecture based on BDI model that facilitates the incorporation of a case-based planning system as the reasoning motor for a deliberative agent. This architecture makes it possible to solve a wide range of problems in terms of agents and multi-agent systems. The problems are resolved in terms of plans, using such plans that have already been experienced. This work solves one of the problems of BDI (deliberative) architectures, which is the lack of learning capacity.

Another work by Corchado et al [15], proposed a re-planning mechanism for deliberative agents as a new approach to tackling the frame problem. They proposed a beliefs, desires, and intentions (BDI) agent architecture using a case-based planning (CBP) mechanism for reasoning. They discussed the characteristics of the problems faced with planning where constraint satisfaction problems (CSP) resources are limited and formulate, through variation techniques, a reasoning model agent to resolve them. The design of the agent proposed, named MRP-Ag (most-replanning agent), are evaluated in different environments using a series of simulation experiments, comparing it with others such as E-Ag (Efficient Agent) and O-Ag (Optimum Agent). Currently there is a limited number of research works on Semantic Web Mining as this is a new field. Berendt, Hotho and Stumme [16] offered an overview of processing activities which are embedded. A generic web log data hypercube is formally defined and schematic designs

for analytical and predictive activities are given.

Various techniques have been utilized to forecast future values. Collopy and Armstrong [17] developed a rule base to make annual extrapolation forecasts for economic and demographic time series. The development of the rule base drew upon protocol analyses of five experts on forecasting methods. This rule base, consisting of 99 rules, combined forecasts from four extrapolation methods according to rules using 18 features of time series. It was found that the improvement in accuracy of the rule based forecasts over equally-weighted combined forecasts was statistically significant. Rule-based forecasting was more accurate than equal-weights combining in situations involving significant trends, low uncertainty, stability, and good domain expertise. Creamer and Stolfo [18] described a link mining algorithm called Corp Interlock and its application to the financial domain. This algorithm selects the largest strongly connected component of a social network and ranks its vertices using several indicators of distance and centrality. These indicators are merged with other relevant indicators in order to forecast new variables using a boosting algorithm. The algorithm Corp Interlock was applied to integrate the metrics of an extended corporate interlock with corporate fundamental variables and analysts' predictions.

IV. ARCHITECTURE OF THE INTELLIGENT ETHICAL WEALTH MANAGEMENT PLANNER (IEWMP)

In this section we will discuss the proposed architecture of our intelligent ethical wealth management planner which will be developed in three stages within the semantic multi agent framework as shown in Fig. 2.

The runtime engine for the ethical wealth management planner will be based on Java technology. The multi-agent technology will be used for mining the web to get the information from various sites around the globe in timely manner [19]. Semantic Web Mining is the technique which mines the web for companies data and retrieve the information. The data miner will extract web information and create new ontology which will be continuously updated [20]. The wealth screening process requires the agent to select companies based on certain criteria such as the investment types, companies activities and companies ethical practices. The methods for the selection include rule based and classification algorithm. The three stages within the semantic multi agent framework are as follows:

A. Constraint Based Semantic Planning

In this process, a model based on constraint based semantic is developed which will be embedded in the agent's reasoning to generate the investment portfolio.

B. Semantic Web Miner Algorithm

A semantic web miner algorithm is developed which will allow an agent to mine the web to collect data relating to company profiles and other relevant information and create a new ontology.

C. Semantic Wealth Forecaster Algorithm

A semantic wealth forecaster algorithm is developed in

this process which generates a forecasted wealth by using established or combinations and new prediction methods based on a set of pre-defined financial constraints.

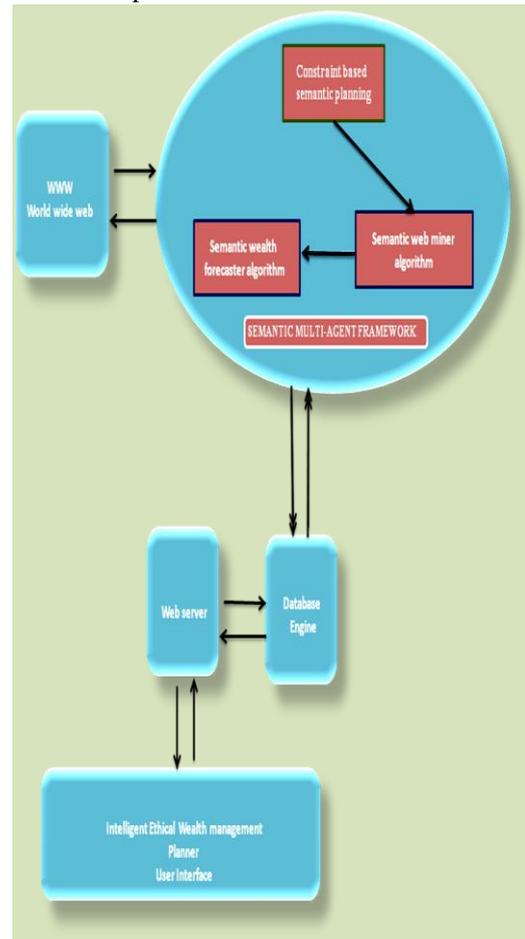


Fig. 2. Architecture of intelligent ethical wealth management planner (iewmp).

Several forecasting techniques will be used for the wealth generation including time series, artificial neural networks and grey theory. These techniques can also be used in combination. The agent is also trained to learn and adapt to the prevailing conditions so that it will be able to improve itself over time. To enable the agent to learn, reinforcement learning will be implemented in the agent's reasoning behaviour. Recommendation shall be performed by taking into account the forecast wealth generation as well as other factors such as current economic situations, government policies and investor's confidence. To do this, constraint based semantic planning will be used to optimally plan the wealth generation. The experiments will consist of evaluating the performance of the wealth planner agent by measuring the success rate level of wealth gained, cost incurred and the ability to learn and adapt over time. For the software, first we create the portfolio management of the client using BIRT [21], an open source software tools that integrates Java/J2EE application for generating clients assets in the graphical manner. For the agent technology we use JADE (Java Agent Development environment) [22] for programming the agents to mine the web. The generated forms of the BIRT are stored in the database connected to Apache Tomcat web server. These generated profiles of the client assets are linked to the webpage from the server and to produce the required application instantly as shown in Fig. 2.

V. CONCLUSIONS

This paper discusses the overview of wealth management in present day industry where the success of the portfolio management purely depends on trust between client and the wealth manager. Our proposed architecture includes using web mining agents for wealth management planner and BIRT for generating the reports of clients. Our modeling is based on semantic multi-agent technology. A step by step procedure will be followed for developing a complete intelligent ethical wealth management planner.

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