

Intelligent Decision System using UI-AKD Approach of D³M

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Abstract— As there is an extent growth in the fields of e-commerce and web technologies in these years, the concepts and applications of decision support systems have been increased significantly. The demand placed on data that is loaded into the data warehouse and queried from this is more. So that it has become a huge overhead for the entrepreneurs and business users which has forced them to manage the data. But the transaction that has happened might be commercial and may have lots of useful knowledge for business decisions in the data warehouse. Through Intelligent Decisions, customers / entrepreneurs are able to make effective decisions concerning the management and direction of their organization. This paper proposes about business intelligent decisions that take place in data-warehouse through the Actionable-Knowledge Discovery (AKD) in Domain Driven Data Mining (D³M for short) using UI-AKD approach. The general architecture of D³M for enterprise decisions was proposed, and its characteristics would be analyzed. The deliverables of D³M were extracted from the result of data mining and knowledge base. The enterprise decisions and reports could be analyzed through D³M deliverables.

Key words: Intelligence Decision, D³M, Actionable Knowledge Discovery (AKD), Data-Warehouse, E-Commerce

I. INTRODUCTION

Electronic commerce (or E-commerce) encompasses all business conducted by means of computer networks. Advances in telecommunications and computer technologies in recent years have made computer networks an integral part of the economic infrastructure. More and more firms/enterprises are facilitating transactions over web. So enterprises recognize the importance of improving their ability to manage customer effectively. E-commerce provides multiple benefits to the consumers in form of availability of goods at lower cost, wider choice and saves time. Customer has become the decisive main resource [4]. So in order to choose from various resources available, customer and entrepreneur has to take intelligent decision as per their domain.

The concept of Business Intelligence (BI) system was put forward by Gartner Group in 1996. At that time, business intelligence would be defined as a technology and its applications; it was made up of data warehouse(or data mart), inquiring report forms, data analysis, data mining, data backup and recovery components, and its purpose was to help enterprise decision-making[1]. With the exponential growth in the amount of data being collected, improvements in technology, and research in machine learning, retailers are now able to reduce the ever growing difficult and complex decision making process by recruiting the efforts of data mining. Data mining is a computerized technology that uses complicated algorithms to find relationships and trends in large databases, real or perceived, previously unknown to the retailer, to promote decision support. Decision making frames are perspectives or maps used by the decision makers to guide the process. As the name suggests, a frame establishes the boundaries and constraints of the process. Decision making frames greatly influence the decision making process.

Business intelligence is a broad category of applications and technologies for gathering, providing access to, and analyzing data for the purpose of helping enterprise users make better business decisions. It implies having a comprehensive knowledge of all factors that affect a business, such as customers, competitors, business partners, economic environment, and internal operations, therefore enabling optimal decisions to be made.

Business intelligence should be utilized at all levels of an organization to promote effective decision making. While it is true that business intelligence is useful throughout the organization, the same type of information is not needed at each level. Different levels within the organization require different types of business intelligence for effective decision making. During the key stage of data analysis, the most powerful Decision Support System is the DSS Analysis tool. Among many early views of Decision Support System (DSS), it identifies that DSS is an interactive computer based system that assists managerial decision makers utilizing data and models to solve semi-structured and unstructured organizational problems from the organizational data-warehouse.

II. ROLE OF AKD IN D³M

In the real world, data mining is a problem-solving process (R) from business problems Ψ (with problem status τ) to problem-solving solutions Φ

$$R : \Psi(\tau_1) \rightarrow \Phi(\tau_2)$$

Gradually, data miners realize that the actionability of a discovered pattern must be assessed by and satisfies domain user needs. To achieve business expectations, business interestingness measures to what degree a pattern is of interest to a

business person from social, economic, personal and psychoanalytic factors. Recently business objective interest is recognized by some researchers, say profit mining and domain-driven data mining, involving business interests. Moreover, business subjective interest also plays essential roles in assessing business interests. This leads to a comprehensive cognition of actionability. There are two sets of interest measures needed to be calculated when a pattern is extracted. For instance, we say a mined association trading rule is (technically) interesting because it satisfies requests on support and confidence.

In the real-world mining, business interests may differ or conflict technical significance. Clearly, actionable knowledge mining targets patterns confirming the relationship that the pattern satisfies both business expectations as well as technical significance. However, it is a kind of artwork to tune thresholds and balance significance and difference between technical and business interestingness. There are two steps in technical interest evolution. The original focus basically was on technical objective interest, which aims to capture the complexities of pattern structure and statistical significance. Technical subjective measures, also recognizes to what extent a pattern is of interest to a particular user.

AKD (Actionable Knowledge Discovery) is an iterative optimization process toward the actionable pattern set P , considering surrounding business environment and problem states. From the modeling perspective, an AKD-based problem-solving process is a state transformation from the source data $DB(\Psi \rightarrow DB)$ to the resulting pattern set $P(\Phi \rightarrow P)$. Let DB be a database related to business problems Ψ , $X = \{x_1, x_2, \dots, x_L\}$ be the set of items in DB , where x_l ($l=1, \dots, L$) be an itemset, and the number of attributes in DB be S . Suppose $E = \{e_1, e_2, \dots, e_k\}$ denotes the environment set, where e_k represents a particular environment setting for AKD. Further,

Let $M = \{m_1, m_2, \dots, m_N\}$ be the data mining method set, where m_n ($n = 1, \dots, N$) is a method. For method m_n , suppose it is identified pattern set $P^{mn} = \{P_1^{mn}, P_2^{mn}, \dots, P_U^{mn}\}$ includes all patterns discovered in DB , where P_u^{mn} ($u=1, \dots, U$) is a pattern discovered by m_n .

- $AKD^{e, \tau, m \in M} : DB \rightarrow P^{mn}$
- $O^{e, \tau, m \in M} \text{ Int}(P)$
- $p \in P$
- \tilde{P}

AKD is critical in promoting the productivity of data mining and knowledge discovery for smart business operations and decision-making rules. With regard to AKD approach, the existing work mainly focuses on developing post-analysis techniques to filter/prune rules, reduce redundancy and summarize learned rules. Real world data mining is a complex problem-solving system. From the view of systems and micro economy, the endogenous character of AKD determines that it is an optimization problem with certain objectives under a particular environment.

III. ARCHITECTURE OF INTELLIGENT DECISION SYSTEM USING UI-AKD

UI-AKD develops unified interestingness and that aggregates and balances both the technical significance and the business expectation. The mined patterns are further converted into deliverables based on domain knowledge and semantics. The term 'actionability' measures the ability of a pattern to suggest a user to take some concrete actions to his/her advantage in the real world. It mainly measures the ability to suggest business decision-making actions. The *Actionable Knowledge Discovery* (AKD) is the procedure to find the *Actionable Pattern* set \tilde{P} through employing all valid methods M . Its mathematical description is as follows:

$$UI-AKD: DB \xrightarrow{e, \tau, M} \tilde{P}, \tilde{R}$$

The interestingness system, which combines technical interestingness ($ti()$) with business expectations ($bi()$) into a unified AKD interestingness system ($i()$). Domain knowledge (Ω_d) and Environment (e) must be considered in the data mining process. Finally the outputs are \tilde{P} and \tilde{R} .

Correspondingly, the *actionability* of a pattern p is measured by $act(p)$:

$$\begin{aligned} act(p) &= O(p \in P \text{ Int}(p)) \\ &\rightarrow O(\alpha t_0(p)) + O(\beta t_s(p)) + \\ &O(\gamma b_0(p)) + O(\delta b_s(p)) \\ &\rightarrow t_0^{act} + t_s^{act} + b_0^{act} + b_s^{act} \\ &\rightarrow t_i^{act} + b_i^{act} \end{aligned}$$

$O(\cdot)$ is the optimization function to extract function to extract those $p \in P$, where $\text{Int}(\tilde{p})$ can beat a given benchmark. Whereas t_0^{act} , t_s^{act} , b_0^{act} and b_s^{act} measure the respective actionable performance in terms of each interestingness element. Due to the inconsistency often existing in different aspects, we often find identified patterns only fitting in one of the following subsets:

$$\text{Int}(p) \rightarrow \{ \{t_i^{act}, b_i^{act}\}, \{-t_i^{act}, b_i^{act}\}, \{t_i^{act}, -b_i^{act}\}, \{-t_i^{act}, -b_i^{act}\} \}$$

Where ' \rightarrow ' indicates satisfactory [1, 2].

The architecture of Intelligent Decision System based on UI-AKD framework is shown below.

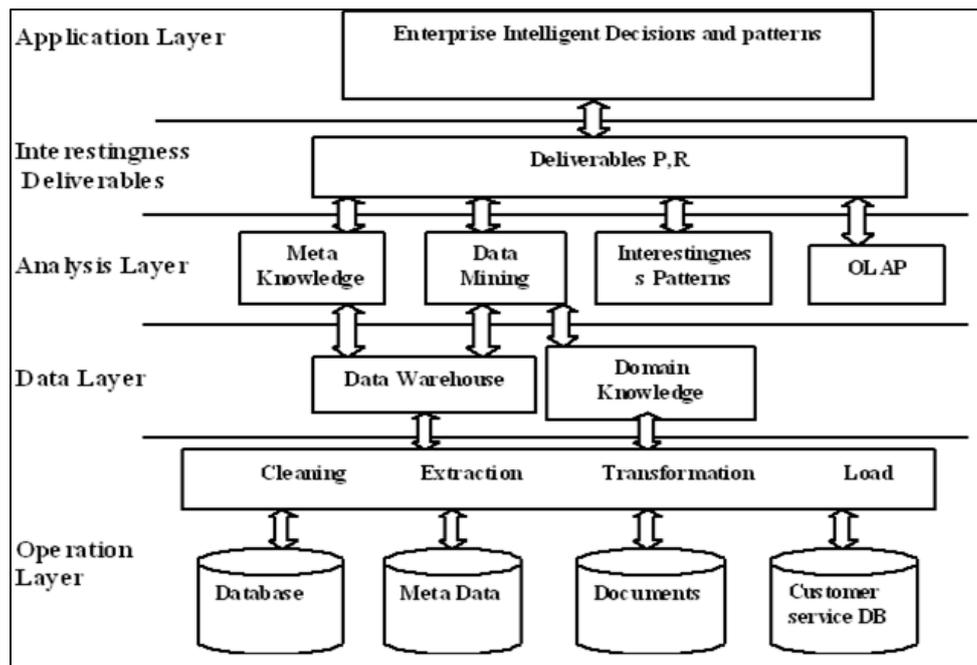


Fig. 1: Architecture of Intelligent Decision System based on UI-AKD framework

IV. D³M ACCESSIBILITY TO INDIVIDUAL SERVICE

D³M for service in individuation is a kind of service modes that supplies different services depending on different customers. It is the best choice when compared to traditional service modes. Individual service on Decision Support System is to supply different services depending on different customers and new application and development of service in individuation. With development of e-commerce, customers need more time and energy to find something interesting and the great quantity of information on internet rather than they do in traditional commerce. In this case, customers/ entrepreneurs need service modes that automatically organize and adjust information according to their demands.

D³M is the most important step to find knowledge in E-commerce consists of two parts: one is to mine information which customers visit web sites to find behavior and mode which customers browse web sites so that customers' interests can be found; the other is to mine data which customers exchange to find association relation between goods so that customer' latent needs can be found. Some methods of D³M can promote individual service even intelligent decision support system. Many research issues of D³M for discovering knowledge in E-commerce that effectively synthesize the above ubiquitous intelligence in AKD-based problem solving systems are listed below.

A. Data Intelligence:

Includes mining in-depth data patterns, and mining structured knowledge in unstructured data. It mines main characteristics from a special group with some same attributes. These characteristics can be used to produce new data items about customers added to database.

B. Domain Intelligence:

It assists in understanding and problem-solving of the problem. Domain intelligence consists of qualitative and quantitative intelligence. Both types of intelligence are instantiated in terms of aspects such as domain knowledge, background information and organizational factors.

C. Network Intelligence:

It includes information retrieval, text mining, and web mining. By the method, customer characteristics visiting a commerce web site can be found according to statistic information and visiting mode. So latent customers can be found and effective commerce measures can be taken.

D. Human Intelligence:

Refers to (1) explicit or direct involvement of humans such as empirical knowledge (2) implicit or indirect involvement of human intelligence such as imaginary thinking, emotional intelligence. We can get a similar customer group according to information in servers. That is to say, it can produce items into a same set explicitly. By the method, marketing strategies can be improved in E-commerce. Automatically send sales mails to special customers implicitly, and when any customer from different groups visit a web site, the web can change its pages for him or her, for example. By the measures, demands of customers can be met in some way to reach marketing targets.

E. Social Intelligence:

Social Intelligence includes collective intelligence, social network analysis, and social cognition interaction. It not only gives a theory frame, but also helps to manage goods and improve Decision support system services in E-commerce.

V. CONCLUSION

In this, we modeled architecture, and designed for Entrepreneur-oriented intelligent decision support systems and discusses about how this approach can be applied to support personalized decision making process in different e-services application domains. In fact, the Domain Driven Data Mining is closely linked to the large potentiality of E-commerce. The more effective enterprises use the information about enterprise customers to meet their needs then the more profitable enterprises will be.

Hence, by using both technical interestingness and business expectations patterns, the customer relationship with the enterprise can be efficiently improved. Later UI-AKD system is then used to extract truly interesting patterns and stored in deliverables from the customer database and knowledge base. And it will inevitably bring intelligent decision system more extensive application prospect and market value. The value must make enterprise in different level compete and win totally with now, and play a vital role to the core competitiveness, which strengthen enterprises.

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