General Analysis of Requirements for Risk-oriented Financial Data Modeling

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***Abstract*—Data modeling is a challenge field in computer engineering. Although researcher made great progresses theoretically, mature technologies in developing and designing are still on the way of exploring. We are engaged in a kind of novel financial data modeling. In the course of our study we found a new method usable in our developing, namely, general analysis of requirements. With this new thought, our work makes breakthrough in process. This paper intends to introduce our study work and the conclusion. We firstly present the new method with which our research is smoothed. We also discuss this method as an exploration in theory. Secondly, we elicit the general requirements for the financial data model from various needs of stakeholders or other roles interested as a common request in the same kind of software usage. Thirdly, we disambiguate the misunderstanding in conception of risk information. Finally we put out the concept of risk used in financial data model as a result of general analysis of requirements. In this paper we also propose the thought of Software Requirements Generalization (SRG) for the first time. This method can be extended to all the computer software designing and developing.**

Keywords- financial data modeling; consepual data modeling; software requirements generalization (SRG)

I. INTRODUCTION

Data modeling is the act of exploring data-oriented structures.[5] Like many other modeling artifacts data models can be used for different purposes, from conceptual models which is in high-level to physical data models which is in low. In object-oriented developing, data modeling is conceptually similar to class modeling from the viewpoint of software engineer. Data modeling usually identifies entity types just as class modeling identifies classes. Data attributes are assigned to entity types whereas you would assign attributes and operations to classes. And commonly, you can establish the associations between entities similar to the associations between classes which are named relationships, that is to say, the relationships in class modeling such as inheritance, composition, and aggregation can be all transplanted to data modeling fields, in which they are all applicable concept.

Data modeling is a first step in the process of object-oriented programming. When data modeling is initiated, firstly you will do the analysis of data objects that are frequently used in a business or other context. Secondly you will identify the relationships among these data objects. After the main works of data modeling, you can then enter into the next step namely defining the classes in which a set of templates for program objects will be provided.

In the RDBMS designing, data modeling is the most important activity. It determines the structures and logical designing of the MIS, and a well designed data model can enhance the software efficiency. However it is hard to develop such a good data model. Engineers often get the data model wrong. The reason is because that our data model designed might not meet what users need. It might be unreliable in use. It might fill up the database with a mess. In fact, it can not do queries, inserts, and updates in efficient way. It is significant that we could define some tables. And defining tables is data modeling.

In financial information system, data modeling is in great significance. When we begin to do data modeling, we are telling the RDBMS to determine the following: what elements of the data the system will store? What kind of information each element can contain? Whether and how various tables are to be linked? How large each element can be assigned? Which elements are constrained to a fixed range? Etc. Answering these questions will found the basis of our frame work of engineering.

It is long time that we do not make a breakthrough in the development of financial data model. Traditional business data model is based on the legacy accounting system which is well known as Double-Entry system, this model has three entities of financial data, and it can ensures that each individual transaction is recorded in at least two different (sections) nominal ledgers of the business bookkeeping system and so implementing a double checking mechanism for every business transaction, which induce an equation relationship. However, it dates from 16 century.

The reasons that financial data model is not developed ahead lay in many factors, but the main factor is because that the requirements analysis of financial data is awkward. Our research has found that analysis of requirements for financial data does not gear with the real need of the system users, so that the contents of information in the outcome of MIS do not fit the use of the information stakeholders. It is high time that innovation should be done to refresh our requirements analysis on users' need so as to develop a new financial data model. We have done a lot in this field. We began all the work with the requirement analysis of financial information use. This paper presents an analysis of requirements for the novel financial data model.

II. METHORD OF GENERAL REQUIREMENT ANALYSIS

Requirements Analysis is the process of understanding the customer needs and expectations from a proposed system or application. Requirements analysis is a key technology in

978-0-7695-4046-7/10 $26.00 © 2010 IEEE
DOI 10.1109/WMSVM.2010.35

the software developing. After requirements analyzing, engineer can determine what kind of information and function the users need should be developed in a software designing.

In common, every software application has its special treatment for user's requirements, for that every application has its special user. Different clients have different needs for the functions of software product. In software designing, each application project deals with its own requirement analysis to gather and capture the information of users, and each specifies its requirements in a document file.

However, we notice that many software application have a similar even the same need in function utilities. Since that the same utility needs generate the same function requirements, prototyping method of development emerge correspondingly, and has its way reasonably. These phenomena give inspiration to us. In that prototyping method can be used in program design, how about we employ it into requirements analysis? Following this, we can do innovations more significantly. Study make out a thought of General Analysis of Requirements is excellent in our study.

We regard the General Analysis of Requirements as the process of generalizing the customer needs and expectations from all the same or similar systems or applications in software engineering. To some extent, it is the iteration of the Requirements Analysis. The differences between General Analysis of Requirements and Requirements Analysis are easy to understand. The former is a common character in some case requirements. The latter depicts how a system should behave or illustrate a description of system properties or attributes. The former is made for a category of software, while the latter is for a single application. The former focuses on the usage mechanism of the category of software, while the latter focuses on the case utilities in operation, despite that they employ abstraction to fulfill their missions respectively.

As mentioned above, we use generalization to fulfill General Analysis of Requirements. In our study, software requirements generalization (SRG) is defined as an abstractive description of the behavior pattern residing in most system of same category to be developed. It includes eliciting requirements which bring or draw out the commonness from the requirements of most application use cases, and disambiguation which resolve concept conflict that occurred when conceptual confusion arise, and acquiring conception which reduce the requirement information content of a concept or a schema typically to retain only basic conceptions which are relevant for software modeling, as well as their relations.

The purpose of General Analysis of Requirements is to model data. Data modeling is an engineering to define and analyze uses' data structures needed to support the business processes of an organization. Data models support data processing and computer systems by providing the definition and format of data. On the basis of data models, data format can trimmed consistently across systems, and then compatibility of data can be achieved. Data modeling can generate the same data structures used to store and access data so that different applications can share data. To fulfill this achievement, data requirements should be firstly done. Since data models are employed iteratively, data requirements should be inducted from lots of private application respectively in the general level. That is Requirements Analysis Generalization. As we see, data modeling needs the General Analysis of Requirements, in another word, the General Analysis of Requirements works for data modeling.

On the basis of requirements generalization, all of the interactions that the users will have with the software will be abstracted into certain conceptions and data schema further. With these result of generalization, engineers can initiate their modeling work and can develop more adaptive and utilizable data model. As you know, after general requirements, associated data definitions have been acquired, and with them a conceptual data model can be established. Actual implementation of the conceptual model called logical data model can be developed. Then a software engineer is going on.

Data modeling techniques and methodologies are employed to model data in a standard, consistent, predictable manner in order to implement the iteration of data use as a resource with same format or structure. The data modeling should erect standards for all projects requiring a standard means of defining and analyzing data within an organization, especially in financial data. Our study is engaged in the financial data modeling. For establishing the new financial data model, we make efforts to induct common conceptions of elements of financial data by way of General Analysis of Requirements.

III. ELICITING NEW ELEMENT FROM BUSINESS DATA

As narrated in the previous section, we have proposed that General Analysis of Requirements includes eliciting requirements, disambiguating requirements，and acquiring conception. We start the general requirements analysis for financial data with eliciting the real needs of financial data user. The following shows our work briefly.

We define that General Requirements Elicitation is the process of discovering the common requirements for a certain kind of systems by analyzing the result of communication with real or latent customers, and system users and other stakeholders who have interests in this kind of system in developing.

Almost all the MIS are developed on basis of accounting information system (AIS). AIS is the core of MIS. Even of ERP is it still. So, AIS becomes the commonness of all the ERP. Any system which interchanges information with ERP or communicates with ERP will send or accept data in AIS used format. Any facility or devise must use the basis schema of AIS data. So, we take time to study AIS in general level which related with the Accounting. The data model of business is come from accounting originally. In order to elicit the general requirement of financial data model we researched the accounting events which are generated in the course of business transactions.

In current accounting practice, business information is categorized into several accounting elements. The contents

of each element are categorized into broad categories. Information in broad categories is divided further into accounting subjects in which data can be used by clients. Like this accounting information is specialized into financial data in degree of accounting subjects. However, Is these data in current MIS meets the user needs? What financial data should be provided to fit for the stakeholder requirements?

Current MIS output, namely business data, emphasizes events influence on accounting elements, which can be measured by the changes of value to present information in accounting subjects such as assets, liabilities, owner's equity and etc. with amounts of these elements, MIS presents data as basic information in commerce exchanges in our modern economic society.

In general, business information exchanged among economic entities in daily economic transaction consists of these accounting elements. Our study found that the accounting elements make up the financial data model. That is to say, financial data model comprise the six accounting elements. All information users, whatever he or her or it is engaged in, uses and exchanges financial data in contents of assets, liabilities, owner's equity, income, expenses, and profit. The current data model established with these accounting elements.

However, such a financial data model sometime does not perform well. In the recent financial crisis arising from America, many enterprises suffer great losses though they have the information based on the legacy financial data model. There is a deficiency in financial forecast system, which is derived from the shortcoming of data model in the MIS. The business information that today's enterprise MIS provides only shows the assets the enterprise holds and the proprietorship of its assets. Both assets and the proprietorship are related with past operating of enterprises. That is to say, the legacy data model focuses its conceptual objects on the information of past economic transactions.

It is put forward in our study that information users or stakeholders are concerned with the information of their enterprise's future operating. Enterprise operating is act of economic transaction. It has been fulfilled in a period with time continuity. When it is measured with accounting it is referred as accounting event. Each accounting event has its own life spans which are passed from happening, to developing and to ending. Accounting events have their past, present and future just like all other ordinary things apprehensibly.

Correspondingly, information about an economic transaction could and should include the past information, the present information and the future information which related its event past span, present span and future span respectively. Obviously, today's business data model have not provide the in formation about future. We need add the future information into the business data model. Up to here, we have already parsed the economic transaction information into three parts, and of course, we elicit a new concept of element of information in the business model. Our general requirements analysis method has been brought into effects in our financial data modeling.

IV. ELIMINATING THE AMBIGUOUS CONCEPT OF RISK

The information about future can be acquired in many data form. One of very often used format is risk expression. There are many definitions of risk that vary by specific application and situational context. It is critical for software engineering to eliminate the ambiguous of the conception of risk. All enterprises and their operating are involved in risk to any extent. So, all information about the enterprise's economic transactions includes the risks.

In Risk Management, many scholars regard risk simply as the probability of something happening, whether good or bad. In practice, the Risk Matrix has become used for determining levels of risk. However, this conceptual does not make the concept of risk clear, because stakeholder will not and can not make correct decision with uncertain figures, and the term "risk" is not just a probability, rather it should becomes a number or factor for determining a relative risk level. It is not adequate to think risk as probability.

More formally and quantitatively speaking, risk is proportional to both the results expected from an event and to the probability of this event. E.g. "Risk is a combination of the likelihood of an occurrence of a hazardous event or exposure(s) and the severity of injury or ill health that can be caused by the event or exposure(s)" (OHSAS 18001:2007). Mathematically, risk often simply defined as:

$$\text{Risk} = (\text{probability of event occurring}) \times (\text{impact of event occurring}). \quad (1)$$

This kind of risk concept and analysis method has become common today in fields like nuclear power, aerospace and the chemical industry. Of course, it is popularly used in economic risk calculation. More sophisticated to say, the mean has been introduced into this method.

However, the mean describes the whole event, while a single event determines the risk by itself. As a general requirements analysis, we need to serve for the whole group of stakeholder to acquire the information of risk. And moreover, information system serves the user separately. We should find the needs in general way, but serve the user respectively. From this perspective, we regard risks as future issues which can be avoided or mitigated, rather than present problems that must be immediately addressed. E.g. "Risk is the unwanted subset of a set of uncertain outcomes." (Cornelius Keating) In this argument, the term risk is commonly used as a concept of hazard. So our risk conception is not simply a mean of losses.

There are many formal methods used to assess or to "measure" risk, considered as one of the critical indicators important for human decision making. In statistics, risk is often mapped to the probability of some event which is seen as undesirable. However, in users' need, they care more about the result but ignore the probability. Given a probability of an event, if an event advent to a particular user, the user's losses is the whole assets that involved in, so the probability is no relation with the single user's loss once the event occur. Therefore, we suppose that risks could be determined by some causes and risks could be measured at the maximum value of its involved value that we have already known or ascertained. It is very important that we

ignore the probability of the risk, and we just consider the maximum of the losses. Hence, after our analysis, risk denoted the absolute value of maximum losses or minimum income. With this disambiguation, we can develop our primary prototype of our data model which concerns with risks.

V. EXPRESSING FUTURE INFORMATION OF A ENTITY

What is the future information of an enterprise? Or to ask, what is the content of information about the risk of an enterprise? To answer these questions, we should make out the conception of present and past information of an enterprise.

The current information of an enterprise is its responsibilities. Since the day an economic entity established as its foundation, it gets its identity from finance of investors, with the force of laws and regulations power. In fact it is a legal entity established by other economic entities, and thus the substance of an entity is the owner's equity and liabilities. Suppose that the enterprise is dismissed instantly. The firm should repay its liabilities and return the investment. So we conclude that the "present" of an entity is its owner's equity and liabilities.

The past information of an enterprise is its assets. The current responsibilities of a firm resulted from the financing activities in the past, and assets accumulated through these activities, can be an indication of the past of a firm. Just like the fortune of one person made through years of persistent hard work can be a symbol of his past life, the assets of a firm accumulated through its operation activities can be an illustration of its history. To conclude, the assets to a firm are its past tense.

Now the meaning of future information of an economic entity, the future span information of an enterprise is allowance for it risks. The future of an enterprise may be examined from the expected income and the reserve funds (for the expected losses), the usage of funds and the uncertainty in its operation. A firm, during its transaction, has no way to judge or predict the environment or circumstance in the next period, so any knowledge about its future is confined to the one of predictions, such as the pre-allocation of funds, the evaluation of the future profitability, or the estimation of the uncertainty of investment risks and premiums related to it. All this information reflects future of the entity. It is risk information.

VI. CONCLUSIONS

We have analyzed the traditional business data model popularly used as basis of general business language. From the user's perspective, the current business data model is based on the traditional accounting system which is well known as Double-Entry system. Sincere that the legacy business dada model just show the assets amount that an enterprise held and describe the proprietorship of its assets, the need to show the stockholders the future information of the enterprises' operating is desirable for those stakeholder and other roles interested.

With the method of general analysis of requirements, we studied that customer using the traditional business information system lack of the ability of cuing and revealing and disclosing uncertain information. We made great effects to reanalyze the financial data requirements in common but not particular user perspective. Thus we made out the general requirement of the common user, and tried to do perfect preparation for financial data modeling. Our work will enhance further the MIS's information service abilities. As you see, the result of our work shows that our method of software requirements generalization (SRG) is effective.

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