Data Modeling And Accounting Information Systems

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ABSTRACT

Historically, accounting information systems (AIS) has not had a unifying theme (McCarthy 1999), although there have certainly been some group efforts aimed at producing an AIS teaching charter. Long laundry lists of technical topics make neither a good course nor a sound curriculum (McCarthy 2003). In recent years, AIS educators increasingly use the data modeling approach to teaching AIS (Hollander et al. 2000; Romney and Steinbart 2000). Evidence suggests that users' participation in the data modeling process is the reason for the considerable attention given to use data modeling in teaching AIS (Byers & Beltz 1994). This article explores data modeling approaches, in specific REA data modeling, that can be used in teaching AIS. It is divided into three sections. The first section introduces the golden age of database by addressing the various methodologies of data modeling. The second section explains the REA data modeling using cardinalities that can be used in delivering AIS classes. The last section summarizes the overall conclusion of the article.

INTRODUCTION

Late 1950s, the American Accounting Association (AAA) started to consider computerized data processing for inclusion in the curricula of accounting education. As such, several committees have been formed since 1959, some of which were:

- 1959 Committee on Accounting Instruction in Electronic Data Processing.
- 1963 Committee on Accounting Systems Instructions.
- 1964 Committee on Electronic Data Processing.
- 1969 Committee on the Role of the Computer in Accounting Education.
- 1970&71 Committee on Information Systems.

Despite of the massive amount of work performed by these committees, the Committee on Information Systems indicated a developed trend that AIS course is recognized as essential to the undergraduate program.

In recent years, the area of accounting information systems (AIS) has been the subject of great controversy in US as well as internationally. The central issue surrounding AIS that basically stems from the absence of AIS general teaching model is that methods of teaching AIS vary substantially across business schools. In specific, an issue of interest is whether data modeling approach should be employed by instructors in teaching AIS courses. This article goes briefly through the golden age of database and explains REA data modeling if it is to be integrated in AIS classes.

DATABASE GOLDEN AGE

Due to the massive amount of data that corporations were in need to treat and store, there was a significance of having database that centrally controlled data files. The years of late 1960s and early 1970s were the middle of database golden age. Codd (1970) developed ideas on relational systems of data for large shared data banks and proposed a relational data model as a basis for protecting users of formatted data systems from the potentially disruptive changes in data representation caused by growth in the data bank and changes in traffic. Codd (1972)

argued that syntactic normalization of the database relational model proved superior in most conceptual and logical systems and network classes due to its application to the problems of redundancy and consistency in the user's model.

Chen (1976) proposed a data model called the entity-relationship model that incorporates some of the important semantic information about the real world. The entity-relationship model can be used as a basis for unification of different views of data the network model, the relational model, and the entity set model.

Smith and Smith (1977) argued that aggregation and generalization are the two kinds of abstraction that are fundamentally important in database design. Aggregation is an abstraction which turns a relationship between objects into an aggregate object. Generalization is an abstraction which turns a class of objects into a generic object. Smith and Smith defined models with a new data type, called generic, that are structured as a set of aggregation hierarchies intersecting with a set of generalization hierarchies. This high level of structure provides a discipline for the organization of relational databases.

McCarthy (1982) addressed the issue of designing accounting data models that can produce well-formulated results in double-entry accounting systems. He proposed a generalized accounting framework system that is called REA accounting model. It is to be used in a shared data environment where both accountants and non-accountants are interested in accounting for the same event. McCarthy (1982) argued that REA accounting model is a general framework that provides comprehensive simple solution to accounting problems such as auditing and internal control.

REA DATA MODELING & CARDINALITIES

Data modeling can be defined as the definition process of a database so that it faithfully represents all key aspects of an organization that are of interest to business environment. Its objective is to explicitly collect and store data about every business activity that the organization wishes to plan, control, or evaluate. Data modeling methodologies such as REA data modeling are used to create conceptual schemas. Schema describes the logical structure of a database. Conceptual level of schema is the organization-wide view of the entire database. Among other data modeling methodologies, it can be argued that REA data modeling methodology provides a teaching competitive advantage in AIS classes because of that (1) it has been specifically developed for use in designing AIS database (McCarthy 1979), (2) REA is adapted to conventions for equity accounting (McCarthy 1982), and (3) it was evident that entity-relationship data modeling approach is found superior over other data modeling methodologies in facilitating the audit review of accounting application (Amer 1993).

According to McCarthy (1979), REA data modeling is a conceptual modeling tool that focuses on the business semantics underlying an organization's value chain. Semantic database design is closely related to object-oriented database design so that its critical step lies on the identification of the most appropriate entities that database analysis can be based on. REA data modeling identifies entities that should be included in AIS database and structures relationships among the entities in that database.

As REA data modeling is seen as a framework that identifies entity-based descriptions of accounting activities, it classifies entities into three major categories: resources, events, and agents. Resources are those objects that have potential utilities and consequently have economic value and under the control of an organization (Ijiri 1975). Examples of these organizational resources are cash, inventory of supplies and merchandise, warehouses and stores¹, and equipment and land. Events are those value chain transactions that reflect changes in organizational resources. Business activities that directly affect the organizational resources are referred to as economic exchanges, and those business activities that create future promises for economic exchanges are referred to as commitments. In a sales revenue cycle, sales and cash receipts are examples of economic exchanges of event entities; sales activities lead to reduction in inventory quantity and cash receipts activities result in increment in cash. Agents are those parties (internal or external) that have been involved in value chain activities. In a sales revenue cycle, salesperson, customer, and cashier are example of agents who may participate in sales transactions.

¹ It has been argued that warehouses and stores are examples of a fourth type of entity named "Locations". In contrary, locations such as warehouses and stores are usually controlled by the organization so that they are classified under resources entities. However, if locations such as warehouses and stores are not controlled by an organization being modeled, then they may be classified as event entities. (Romney & Steinbart, 2003)

The development of REA diagram entails the following procedures:

- Identifying the pair of economic exchange events that best represent the relationship in the cycle. One event may increase some resource and the other event may decrease some resource. Each economic event should be analyzed to determine whether commitments are to be considered.
- Identify the resources that have been influenced by each economic event and identify the agents who have been involved in these events.
- Describe the relationships between identified entities in numerical forms (Cardinalities)².

As stated above that REA diagram final step requires the addition of information about the relationships nature between various entities. This additional information is expressed by means of numerical relationship and referred to as cardinalities. For the purpose of this paper, Batini et al (1992) notation is used for determining cardinalities. Therefore, the pairs of letters and numbers that appear next to each entity represent the minimum and maximum cardinalities respectively. Entities represent a class or set of objects. For example, purchases entity represents all the individual purchases transactions that occur during the period and the supplier entity represents all of the organization's suppliers. Each individual purchases and supplier transaction represents a specific instance of the entity.

As cardinalities are used to express numerical relationships among entities, cardinalities indicate the number of times an instance of an entity can participate in a relationship with another entity. In a relational database, each entity represents a table and each instance represents a row in that table. So, cardinalities indicate the number of rows in a table that can be linked to a specific row in another table. Cardinalities are of two types: minimum and maximum cardinality. Minimum cardinality refers to the nature of entities relationship as whether it is optional or mandatory in the sense that it indicates whether a row in a table must be linked to at least one row in another table. Maximum cardinality indicates whether a row in a table can be linked to rows in another table.

To illustrate the implication of cardinalities, an example of purchases expenditure cycle is considered. Bryant Company only purchases paper cuttings. The general terms of its purchases that Bryant pays using only bank check account for each transaction one third of the purchase price with the remaining to be paid when the cutting is sold.

The cardinalities between events and agents are typical in the sense that each event must participate in a relationship with one type of agent, and at most one type of agent; conversely, each agent can participate in a relationship with many events, but may be related to no event (this is the situation where new supplier can be added without being linked to any event). In addition, the cardinalities between resources such as master files (i.e., cash and inventory) and events are typical in the sense that a new entry can be added to a resource entity without having to be linked to a specific event entity. As such, the cardinality that appears next to the cash in a Cash-Cash Disbursements relationship is (0,N) because cash is a master file and some cash accounts (e.g., the savings account) may never be used to pay-off for purchases transactions. The cardinality that appears next to the cash disbursements in a Cash Disbursements-Cash relationship is (1,1) because in Bryant situation each prepared check must be made on one, and only one check account bearing in mind that this situation may vary from one case to another.

Given that Bryant Company purchases one type of inventory items, the cardinality that appears next to the inventory in an Inventory-Purchases relationship is (0,1) because at an inventory item can be added without having to be related to a purchase event and a given inventory item could only have been purchased one time. The cardinality that appears next to purchases in a Purchases-Inventory relationship is (1,N) because each purchase transaction must participate in at least one cutting, and may participate in many cuttings. The cardinality that appears next to purchases in a Purchases-Cash Disbursements relationship is (0,N) because the purchase transaction happens before the cash disbursement in time and paid over installments in according to Bryant case. The cardinality that appears next to cash disbursements in a Cash Disbursements-Purchases relationship is (1,1) because cash disbursements happens after the purchase transaction in time and checks are made to individual suppliers for specific purchase transactions.

² Various approaches can be applied to determine cardinalities. Some of which are: Batini notations that can be used in AIS data modeling; Elmasri notations that are commonly used in MIS data modeling; Graphical notations that are used in Oracle database products; and Maximums-Only notations that are used in Microsoft software such as MS Access.

Figure 1: REA Data Modeling Sample For Purchases Expenditure Cycle (Source: Romney & Steinbart 2003)

CONCLUSION

The recent increasingly use of data modeling approach in teaching AIS course may indicate that data modeling materials enhance instructors' desire to teach AIS. This article introduces REA data modeling as an accounting model that can be integrated in AIS classes so that well-formulated results can be obtained in double-entry accounting systems. REA data modeling using cardinalities is explained and the golden age of data base theory is also addressed. It can be summarized that REA data modeling provides a teaching competitive advantage among other data modeling approaches in AIS classes because of its generalized nature of framework that leads to comprehensive simple solutions to accounting problems such as auditing and internal control (McCarthy 1982).

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