

# A Control-Data-Mapping Entity-Relationship Model for Internal Controls Construction in Database Design

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## ABSTRACT

*The internal controls construction of a transaction system is important to management, operation and auditing. In the environment of manual operation, the internal controls of the transaction process are all done by manual mechanism. However, after the transaction processing environment has been changed from manual operation to computerized operation, the internal control techniques have been gradually transformed from manual mechanisms to computerized methods. The essence of internal controls in operational activities is the data expressions or constraints. The adoption of information systems often results in internal control deficiencies and operating risks due to the data unavailable in database for the data expressions of internal controls. Hence, how to design database schema to support internal controls mechanism is becoming a crucial issue for a computerized enterprise. Therefore, this paper referred Entity-Relationship model (ER model) in order to propose a Control-Data-Mapping Entity-relationship (CDMER) model by manipulating the required fields of tables to design database to support internal controls construction. Finally, a simple simulated case is prepared for illustration of the CDMER model. The contribution of this paper is to enhance the reliability of information systems through internal controls construction by applying the model to design databases.*

*Keywords:* Control-Data-Mapping Entity-Relationship (CDMER) Model, Database Design, Information Systems, Internal Controls Construction, Internal Control Deficiency

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## INTRODUCTION

Internal controls are defined as controls that are introduced in an organization to safeguard

its assets, to protect the accuracy and reliability of the accounting data, to promote operational efficiency, and to encourage compliance with management policies and procedures (Romney

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& Steinbart, 2009). A more detailed discussion of internal controls is given in Section 2. With the advancement of information technology, organizations rely significantly on information systems to support their transactions and data processing. Information systems have played a crucial role in business operation. The manual mechanisms of traditional internal controls need to be re-designed and transformed into automated controls to achieve control objectives (Stringer & Carey, 2002). As information systems should undertake more internal control functions, the reliability of information systems becomes an important issue. Managerial problems and operational risks may arise if the automated control mechanisms are not properly implemented into information systems.

As the business rules are introduced for the integrity of transactions, the database constraints are in place for the accuracy of data processing. While transaction activities are mapped against data processing, internal control rules are mapped to database constraints. In other words, the essence of internal controls in operational activities is the data expressions or constraints in database (Doty et al., 1989; Tsamoura et al., 2011). The transaction data corresponding to the requirements of internal controls should be built into the database for enabling the presentation of the data expressions and constraints. However, IT professionals didn't pay much attention to the above issue during database design process. As indicated by Bohem (1976) that it takes much more efforts to install the requirements at post-implementation stage than at analysis and design stage. Therefore, to design database schema incorporating the information needs of internal controls become a crucial issue for computerized organizations.

In 1976 Peter Chen published the original entity-relationship (ER) model which provided a friendly approach to logical database design (Chen, 1976). The model is comprehensive, yet it avoids the complications of storage and efficiency considerations, which are reserved for physical database design. In the more than three decades since then, a lot of users have adopted the original model and used it enthusiastically

after minor changes. In addition, a number of researchers have extended the model to enhance its capabilities so that it is more appropriate for their particular endeavor. The most comprehensive extension includes REA accounting model which shares the enterprise financial and non-financial data proposed by McCarthy (1982).

Therefore, this study uses the mapping mechanisms between controls and data of internal controls in transaction activities, referred Entity-relationship model to propose a Control-Data-Mapping Entity-Relationship (CDMER) model. By using this model, the operational rules are mapped to data expressions, and data expressions are analyzed to design the desired database schema, during the developing stage of information systems. Finally, a simple simulated case is prepared for illustration of the CDMER model. It will enhance the reliability of information systems through internal controls construction by applying the model to design databases.

## LITERATURE REVIEW

### Internal Controls

Internal controls, which are policies, regulations, or measures implemented by the board of directors, management and others, aim to provide a reasonable assurance of the reliability of financial reporting, the compliance with laws and regulations and the effectiveness and efficiency of operating (Bailey Jr. et al., 1985; Baird & Rasmussen, 2002; Cunningham, 2004; Gelinas et al., 1999; Gibbs & Keating, 1995; Korvin et al., 2004; Romney & Steinbart, 2009). The quality of the design of internal controls, more often than not, is critical to the success of an organization. Therefore, to ensure the efficacy of internal controls, managers have to pay attention to the design of internal controls.

Doty et al. (1989) argued that the similarity between an organization's internal control techniques and expressions or constraints in database. They suggested that a constraint or an expression is a property which, for a set or

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