A Relational Decision Support System for EDI Auditing

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ABSRACT

The purpose of this paper is to introduce EDIRDB (EDI auditing decision support system using a relational database system), a prototype audit support system based on a relational database designed to act as a decision aid for EDI auditors. The EDIRDB database consists of nine tables: (1) four tables from the entities ENVIRONMENTS, CONTROLS, RISKS, and TESTS, and (2) five tables corresponding to the relations between each of the four entities. Managers can suggest required controls, relevant risks, and test procedures from results coming through cross referencing (e.g., JOIN, PROJECTION, and SELECT commands) between the nine base tables.

KEY WORDS

EDI, relational database system, environments, controls, risks, tests

1. Introduction

One of the critical aspects for EDI auditing is the need to suggest a cost-benefit design of EDI controls and to assess the risk. Appropriate test procedures should then be suggested. EDI controls should be designed so that they focus on vulnerable subsystems in order to reduce overall risks. More resources need to be invested for the auditing and designing of controls in these vulnerable subsystems. Furthermore, the relation between controls and risks must be established in order to validate the effectiveness of these controls. It is equally important to investigate whether these controls are functioning effectively. Various evidence collection procedures (e.g., code review, test data, integrated test facility) are suggested in order to assess the quality of EDI controls.
The relational decision support system has been theoretically studied for its extended effectiveness in decision-support (Dell'Aquila et al., 1989; Suh and Hinomoto, 1989), especially in the determination of the scope of evidence collection, by providing information about the location of where controls are needed (Hansen and Messier, 1984). The purpose of this paper is to introduce EDIRDB (EDI controls design support system using relational database system), a prototype audit support system based on a relational database designed to act as a decision aid for EDI auditors. This paper describes how EDIRDB functions and explicates the means by which a relational database is utilized to support the design of EDI controls; it also suggests relevant risks from the absence of some controls, and proposes test results. The system recommends effective controls and shows relevant risks in specific organizational contexts, suggesting test procedures for specific companies.

2. E-R Diagram and Database Design

One widely-known approach in semantic modeling for the design of databases is the so-called Entity-Relationship (E-R) approach (Chen, 1988). The complicated interconnections between controls, risks, environments, and tests can be conceptually represented using the data modeling approach. Five tables can be produced from these relations between entities, in addition to showing four tables from each individual entity. Major relations are constructed as follows:

ENVIRONMENTS (ORGANIZATION_#, ORGANIZATION_NAME,
ORGANIZATION_INDUSTRY, ORGANIZATION_SIZE)
CONTROLS (CONTROL_#, CONTROL_CLASS, CONTROL_DESCRIPTION)
RISKS (RISK_#, RISK_CLASS, RISK_DESCRIPTION)
TESTS (TEST_#, TEST_CLASS, TEST_DESCRIPTION)
ENVIRONMENT_CONTROLS (ORGANIZATION_#, CONTROL_#,
CONTROL_STATE, CONTROL_DATE)
CONTROL_RISKS (CONTROL_#, RISK_#, CONTROL_RISK_RELATION)
CONTROL_TESTS (CONTROL_#, TEST_#, TEST_RELEVANCE)
ENVIRONMENT_RISKS (ORGANIZATION_#, RISK_#, RISK_LEVEL,
RISK_DATE)
ENVIRONMENT_TESTS (ORGANIZATION_#, TEST_#, RESULT_#,
TEST_RESULT, RESULT_DESCRIPTION,
TEST_DATE)

The ENVIRONMENTS table includes the following attributes: ORGANIZATION_#, ORGANIZATION_NAME, ORGANIZATION_INDUSTRY, and ORGANIZATION_SIZE. An ENVIRONENTS entity can have six sub-entities: INDUSTRY, IS, TASK, PARTNER, and PERFORMANCE. These represent industry, IS, task, partnership characteristics, and overall EDI performance, respectively.

The table CONTROLS represents the EDI control procedures. The objective of EDI controls is to ensure that an organization achieves its goals through the implementation of EDI. They are activities to safeguard assets, maintain data integrity, effectively accomplish organizational goals, and efficiently consume resources. Before EDI auditors recommend controls, a list of available control measures must be identified. Measures for EDI controls for this study were newly developed, for which various sources (Chan, 1993; ISACA, 1990) were referred to.

The table of RISKS shows various risks from the implementation of EDI. Each progressive level of integration represents a higher level of sophistication, dependency, and vulnerability. The table TESTS indicates the test procedures that examine whether a given portion of a computerized system is properly functioning. There are many test techniques used to control highly automated systems: concurrent audit techniques; electronic audits trails; continuous and intermittent simulations (CIS) techniques; real-time feedback from integrity checks; and parallel simulation techniques to audit batch processing. Concurrent auditing techniques identify problems in application systems on a more timely basis, and use embedded modules in application systems or system software to collect, process, and print audit evidence.

The *Environments for Controls* relation indicates the relation between ENVIRONMENTS and CONTROLS. The ENVIRONMENT_CONTROLS table stores the environmental status and the control status in each environment (Table 1). This relation can provide information about the appropriate controls in certain environmental contexts, by enabling auditors to systematically retrieve cases with high performance from among similar cases in the same environment as the case in question. The value of the CONTROL_STATE field of the ENVIRONMENT_CONTROLS table indicates the usage level of controls, and is assessed using seven-point Likert-type scales.

Table 1: ENVIRONMENT_CONTROLS Table

ORGANIZATION_#	CONTROL_#	CONTROL_STATE	CONTROL_DATE
101	101	4	7/21/1997
101	103	3	8/11/1998
101	104	3	3/10/1998
102	104	4	2/11/1996
103	104	5	2/12/1996
101	102	7	9/15/1997
102	103	2	12/22/1997

The *Risks for Controls* relation relates CONTROLS and RISKS entities, and indicates the relation between controls and risks. The CONTROL_RISK_RELATION in the CONTROL_RISKS table describes the importance of controls for the reduction of risk or the possible amount of risk caused by the absence of controls. (Table 2).

CONTROL_RISK_RELATION uses seven-point Likert-type scales according to the strength of the relation. If the set of risks and controls are defined and the relations between the two sets are constructed, the importance of EDI controls can be induced in view of their contribution to the reduction of overall risks.

Table 2: CONTROL_RISKS Table

CONTROL_#	RISK_#	CONTROL_RISK_RELATIO N
101	102	6
101	103	5
101	101	5
201	103	1
202	103	4
104	103	7
104	101	4

The *Test Procedures for Controls* relation represents the relevant test procedures to examine whether controls are appropriately functioning. The CONTROL_TESTS table represents the candidate test procedures for controls (Table 3). TEST_RELEVANCE has seven internal scales ranging from *Very Low* to *Very High* according to the extent to which the test procedure is related to control.

Table 3: CONTROL_TESTS Table

CONTROL_#	TEST_#	TEST_RELEVANCE
101	102	Moderately High
101	103	Very Low
101	105	Very High
201	103	Very Low
102	103	Moderately High
202	103	Moderate
103	104	Very High

The *Risks of Environments* relation (ENVIRONMENT_RISKS table) represents the level of risks in firms within a specific environmental status (Table 4). RISK_LEVEL has seven internal scales ranging from *Very Low* to *Very High* according to the "real" risk level of a company and is determined from risk analysis after controls are implemented. RISK_DATE indicates the last date when the risk level of environments was measured.

Table 4: ENVIRONMENT_RISKS Table

ORGANIZATION_#	RISK_#	RISK_LEVEL	RISK_DATE
102	101	Moderately High	3/13/1996
102	103	Moderate	11/21/1997
101	105	High	4/9/1998
201	105	Moderate	12/10/1997
101	104	High	7/1/1997
102	102	Very High	2/10/1996
101	103	Very Low	7/20/1998

The *Test Results of Environments* relation (ENVIRONMENT_TESTS table) indicates the results of test procedures applied to the environment of an organization (Table 5). The test results constitute evidence on the reliability of organizational environments. When test results of some environments are unsatisfactory, it indicates that these organizations do not operate EDI controls as they are purported to. Other relations, CONTROL_TESTS and ENVIRONMENT_CONTROLS, should be joined with ENVIRONMENT_TESTS to explain the test results regarding different controls. The attribute TEST_RESULT has seven internal scales ranging from *Very Bad* to *Very Good* according to the extent to which controls satisfy the criteria of test procedures.

Table 5: ENVIRONMENT_TESTS Table

ORGANIZATION_#	TEST_#	RESULT_#	TEST_	RESULT_DESCRIPTION	TEST_DAT

			RESULT		E
101	102	201	Bad	Transactions not correctly recorded in accounting records	3/13/1996
101	104	204	Moderate	Organization recover from failures within appropriate times	3/15/1996
101	105	205	Very Good	All transactions received are passed to each relevant applications and only once	3/181996
101	103	210	Very Bad	Unauthorized messages sent or received and acted upon	12/10/1997
103	103	301	Good	Encryption keys are kept secure and private	7/1/1998
104	103	302	Bad	Introduction of non-authentic transactions	12/10/1998
107	101	304	Moderate	Incorrect translation of application data to/from interchange document	12/20/1998

3. Recommendation of Controls

EDI auditors are required to systematically analyze cases which are similar to their current environment, cases which have successfully implemented EDI controls. Because successful controls lead to high performance, it is necessary to find cases that display high performance. The recommended controls for a certain organizational context can be predicted from parallel past cases in which controls were well-established. EDI managers may invest IS resources to implement the same controls that were considered important in these past cases.

One case was randomly selected from our database and analyzed to show how EDIRDB can help auditors make decisions. EDI performance depends on the extent to which companies have appropriately established controls; the competitive advantage derived from EDI can only be maintained if the integrity and accuracy of the data is controlled. It is assumed that if companies then have higher performance than do others, the new EDI controls that have been implemented are more appropriate.

The cases with the highest performance are selected from similar cases and retrieved through the SELECT and PROJECTION commands. If the auditor's subjective prediction of the most recommendable cases also coincides with those that the EDI system has generated from these same most similar cases, better decisions on the level of controls can be made. In most cases, auditors should also examine this added information from the retrieved cases, and select those most relevant to the audit's purpose. The auditor can obtain other useful information by requesting complete information about the selected cases from the database. The system can display this complete information about the organization, as well as EDI performance for the selected history of the client.

When EDI auditors implement controls that are related to high performance, they can search cases by: (1) joining the ENVIRONMENTS, ENVIRONMENT_CONTROLS, and CONTROLS tables; (2) selecting the tuple of joined tables where the attribute values in INDUSTRY, IS, TASK, and PARTNERS are similar to the current case; and (3) finding similar cases with the highest performance.

These operations can be expressed in a *view*. The following *view* shows an example of the retrieval of cases, in order to recommend additional EDI controls.

```
CREATE  VIEW   ORGANIZATION_CONTROLS
    AS  SELECT  ORGANIZATION_NAME, ORGANIZATION_#, CONTROL_CLASS,
                CONTROL_#, CONTROL_DESCRIPTION,
        FROM    ENVIRONMENTS, ENVIRONMENT_CONTROLS, CONTROLS
        WHERE   CONTROL.CONTROL_# =
        AND     ENVIRONMENT_CONTROLS. CONTROL_#
        AND     ENVIRONMENT.ORGANIZATION_#
        AND     ENVIRONMENT_CONTROLS. ORGANIZATION _#
        AND     EXTERNAL_INFLUENCES > 5
        AND     EXTERNAL_INFLUENCES < 6
        AND     PROFESSIONALSIM > 1.5
        AND     PROFESSIONALSIM < 2.5
        AND     DECENTRALIZATION >4
```

AND DECENTRALIZATION < 5
AND MANAGERIAL ATTITUDE > 3.5
AND MANAGERIAL ATTITUDE < 4.5

An EDI auditor can identify critical controls through the systematic analysis of retrieved cases. The case that has the highest performance values should of course be selected. In our study, the selected case is Case 48 (Table 6), which has the highest value in performance among the ten cases retrieved (IMPROVED_RELATION = 6.1, COMPETITIVE_ADVANTAGE = 6.4). From the selected case, it is possible to determine the controls that effectively affect performance. Controls with a score greater than or equal to five (this "cutoff" usage level of five is arbitrarily set and just represents the level that discriminates the "high" and "low" usage level of controls in the Case 48) are marked. These controls are highly used in Case 48 and might have contributed to the high performance value of Case 48 more than other controls. Five of sixteen EDI controls have a value greater than (or equal to) five. Auditors, or the organization management, should place the utmost emphasis on these controls.

Table 6: The Recommended Similar Case (* has higher (or equal to) than 5)

Control class	Average usage level of controls in Case48
internal formal application controls	3.75
internal formal communication controls	5*
external formal VAN controls	4
external formal partner controls	4
internal informal controls from risk recognition	4
internal informal controls from sense of responsibility	5*
internal informal controls from experience	4.75
internal informal controls from interaction	3.5
external informal controls from risk recognition	4
external informal controls from sense of responsibility	5*
external informal controls from experience	5*
external informal controls from interaction	5*
internal automated application controls	3.75
internal automated communication controls	4
external automated VAN controls	4
external automated partner controls	2

4. Conclusion

EDIRDB has been developed to support EDI auditors in finding the controls that fit a specific firm within a certain environmental context, and to suggest possible risks and further test procedures. Using EDIRDB, controls are recommended using the database's control procedures along with a company's own environmental information. This system does improve the efficiency and effectiveness of EDI auditing, and can be further applied to general EDP auditing.

EDI auditors can identify critical controls through our systematic analysis of similar cases. Controls are critical if they are highly implemented in cases that are environmentally similar and result in high system performance. The controls should both be effective in reducing risks and lead to high performance. Controls that can significantly decrease the level of risks are recommended. Further, because controls demand appropriate test procedures to examine whether they have been successfully implemented, it is therefore critical to suggest further test procedures relevant to those new controls.

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