A CASE-BASED APPROACH TO THE EVALUATION OF NEW AUDIT CLIENTS

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SYNOPSIS

Evaluating a potential client is an expensive undertaking. Potential clients are evaluated through extensive interviews, evaluation by in-house industry experts, and preliminary audit planning. The audit partner uses prior experience to make judgments about a prospective client. Decisions about a client have long lasting implications for the auditor and the client. Case-based reasoning is an information technology that can be applied to the evaluation process to broaden and deepen the audit partner's judgments. This paper demonstrates how case-based reasoning can improve the audit acceptance process. The inherent difficulties of new client acceptance are reviewed. An overview of case-based reasoning is provided. We then demonstrate how case-based reasoning can increase the quality of firm specific assessment when evaluating potential audit risk associated with a new client. Finally, we discuss the expected implementation impacts arising from the application of case-based reasoning.

Key words: Case-Based Reasoning, CBR, Audit Engagement Acceptance, Audit Risk Assessment, Audit Pricing.

INTRODUCTION

The decision to accept a new client or continue the contract of an existing client is a difficult task for CPA firms. Every time a firm considers signing a contract for attestation services, it needs to consider the three components of engagement risk: (1) client's business risk, (2) audit risk, and (3) auditor's business risk. The CPA firm needs to perform this risk assessment in a cost effective manner, since it will pass the cost along to the client. If the firm spends excessive amounts of time on the assessment, it risks having no clients if audit procedures and fees sky rocket. However, if it does not perform the risk assessment, it faces possible future negative consequences from audit failure, litigation and loss of reputation. The importance of risk assessment has never been clearer with the business press declaring that the accounting profession is in crisis in the wake of Arthur Anderson/ Enron debacle (Byrnes et al 2002). In fact, CPA firms are using the client-acceptance process as the first stage in controlling their risk (MacDonald 1997).

Costly professional standards have been developed to guide a CPA's evaluation of a prospective client. The American Institute of Certified Public Accountants (AICPA) (1999) has set out 11 procedures that an auditing firm may consider performing when evaluating retention of a current client or acceptance of a new client. These procedures include investigating the reputation of officers, directors, and key shareholders, gaining a reasonable understanding of the client's business, and investigating all claims in SEC 8-K disclosure forms prepared by the outgoing CPA.

What is emerging in the literature is an understanding that CPAs must reject some clients. Thomas (1992) indicated that the CPA should consider the incremental costs associated with ensuring they can create the capacity needed to serve the client and how association with the client will affect other aspects of their business. The AICPA (1999) has further endorsed this position by requiring the auditor to consider the prospective client's ability to pay a reasonable fee for the services required. Danziger (1999) has gone even further and noted that clients must be selected based on the firm's relative strength.

According to Thomas (1992) and Danzinger (1999) the decision to accept a new client ultimately depends on the judgment of the audit partner. The professional evaluation standards are met through interviews and research conducted by the partner. However these procedures are limited by our natural limits to gather cost-effective data. According to Brynes et al. (2002) residual consulting fees from audit clients usually are greater than the primary audit fee. This produces audit fee pressure. A particular concern is Houston's (1999) finding that audit partners are less sensitive to risks associated with a client when there are fee pressures. He also found that audit procedures are reduced when there is fee pressure. As accounting services become more competitive, any way to reduce costs without diminishing the quality of an audit client evaluation is a strategic advantage.

Case-based reasoning (CBR) is a means of improving the client evaluation process and of lowering engagement risk at a lower cost than the less effective strategies currently in use. CBR offers the prospect of increasing the audit partner's access to firm-specific experiences with similar audits. This should improve decision-making by streamlining the information gathering process. The streamlined approach will enable the audit partner to discover, much earlier in the investigation process, if the firm has a competitive advantage or disadvantage based on a comprehensive review of all applicable firm specific audit experiences.

Our research objective is to examine the applicability of CBR to the expensive process of new client evaluation. This paper provides a discussion of engagement risk and an explanation of the CBR technology. We developed a demonstration of the technology to test its applicability to the evaluation of new audit clients. We have concluded that CBR could provide a significant reduction in evaluation costs while simultaneously improving the

data available to the audit partner charged with reaching a go-no go decision about bidding on a prospective audit.

ENGAGEMENT RISK

The AICPA introduced the concept of engagement risk in its *1994 Audit Risk Alert*. Engagement risk is the overall risk associated with accepting a new audit client or continuing with a current client. It is composed of three components: (1) client's business risk, (2) audit risk, and (3) auditor's business risk. Client's business risk is concerned with factors that affect the profitability and continuing existence of the business entity. Audit risk is defined as the risk that the auditor may unknowingly fail to appropriately modify the opinion on financial statements that are materially misstated (AICPA 1983). Auditor's business risk concerns the possibility that the auditor is exposed to loss or injury to his professional practice from litigation, adverse publicity, or other events arising in connection with financial statements that he has examined and reported on (AICPA 1983).

The client's business risk is the one component of engagement risk over which the auditor has no control. The auditor attempts to control this risk by managing audit risk, which is solely determined by the auditor, and auditor's business risk, which can be controlled to some degree by the auditor (Colbert et. al. 1996). Previous research has examined the relationship between client's business risk and audit risk. The results indicate that a two-way relationship exists between client's business risk and audit risk. A client's financial condition, which is measured by client's business risk, can affect the evaluation of audit risk. Likewise, the audit might discover facts that will have a negative effect on the client's audit opinion (Kruetzfeldt and Wallace 1986; O'Keefe et al. 1994; Palmrose 1987).

Johnstone and Bedard (2000) developed and tested a model that examined the characteristics of the client acceptance process utilizing the three risk components of engagement risk and risk adaptation. The results indicated that audit partners consider the characteristics of client business risk and the resulting potential effects on auditor's business risk. The results also showed that audit firms did not adjust fees or audit procedures for more risky clients. The firms chose risk avoidance, rejecting the client, instead of adapting audit procedures and raising fees to make these clients more acceptable. This progression reveals a complex cognitive process is used in the decision process. A general theory for such Business to Business (B2B) is emerging (Lee and Kwon, 2006). In this context case-based reasoning is emerging as a useful tool that enables a richer consideration of business experiences in the decision making process.

CASE-BASED REASONING

CBR is a promising form of artificial intelligence that has many possible applications. It is especially useful in situations where a set of previously developed heuristics can be applied to a new problem to arrive at a potentially successful solution. Cases are a store of similar successful and unsuccessful situations can be used to guide future actions. They are an accumulated body of problem-solving experiences that can be used as analogies. A specific CBR model involves four distinct processes (Grupe 1993). First, a situational assessment is conducted to determine the parameters of the situation or problem and what information is available. The second process involves searching for past cases that may provide some information that could lead to a full or partial solution of the current case situation. The third step involves considering the circumstances so that the cases most pertinent to the current situation are retrieved. Finally the most appropriate case must be evaluated to see if it provides a satisfactory solution.

The use of cases is a distinctive advantage of the CBR model when it comes to solving complex problems. A CBR model does not remove the need for professional judgment. It does offer the professional an efficient way to gather the most pertinent previous experiences of the organization for application to the current problem. The system allows a professional to make a more comprehensive judgment than is possible by relying on remembered experience alone. Cases are themselves complex entities which encapsulate many facts and relationships about incidents in a specific context. The author of the case does not have to recognize the importance of every aspect of the case in order for it to be used. Riesbeck and Schank (1989) identified CBR applications used for dispute and conflict resolution, plan adaptation, recipe and plan modification, legal argumentation, corporate merger analysis, and medical diagnosis. Application to lending decisions is typical of the new type applications CBR is being applied to (Kersnar, 2006). Cases can be applied to fields as diverse as business education and military planning, advertising and law, and arbitration and trouble shooting.

Cases are a convenient way of capturing situational data to support decision-making. A case is an accumulated body of problem solving experience. As with individual expertise, the value of the case base increases as the volume of cases increases. It is not necessary to wait, however, until all cases have been developed before the system can be used. With CBR as few as one previous case can provide valuable information for a current problem while many other forms of quantitative analysis and decision support require larger data bases and many data points (Yin 1993). The knowledge encapsulated in the first case might be helpful in solving the second case. It is also not necessary to have a complete conceptual understanding about a situation before starting because cases capture knowledge easily. The structure of cases is much less constrained than are, for example, expert systems. There is no need for discovering complex interrelations between cases as there is when fully elaborating an expert system's rules. Consequently, case bases come online faster and they stay online even as cases are being altered or eliminated. Learning is incremental and ongoing.

We understand much of the world in terms of cases. A variety of techniques are used to structure CBR systems for efficient case storage and retrieval. The basic organization and functioning of such systems is logical and easy to follow because they are familiar process to decision makers how work in complex situations. Decision makers feel better about using systems that present the world in a format with which they are familiar. In this way CBR augments their capabilities because it can recall a richer set of cases than a decision maker can without assistance. Its utility also persists beyond the presence of any specific decision maker. A CBR system thoroughly and neutrally evaluates all possibilities before making a recommendation. As new circumstances arise and experience is gained an organization's ability to handle a case problem and therefore determine a successful solution changes. A CBR model incorporates new learning easily.

In a CBR environment learning is achieved by making full use of previous experiences available to the firm. Learning is best demonstrated in a circumstance when none of the cases in the case base satisfactorily solves the problem. A solution must be

identified in another manner. An obvious solution is to ask an expert to study the problem and suggest a solution. Zhang (2004) demonstrated this approach in development of a case based virtual mentor. An alternative approach is to augment the available case base with a rule that fixes or repairs those cases that are close to what is needed. This approach was more evident in Mitri's (2003) approach to curriculum assessment. In these ways a new client with unique characteristics can be assessed with enhanced expertise with reference to cases with some similar attributes. In such cases we could introduce an adjustment to the case data based. The result is learning based on a richer use of the firm's previous business experiences.

Expert systems rely on a set of rules. There are times when rule-based or case-based approaches can be used to solve problems (Choobineh and Lo,2006). Cases are not written as a set of rules as they are in expert systems for two reasons. First, the developers are often unsure what the rules are that an expert used when solving a case problem. Second, cases may not encompass a complete universe of cases and solutions in a domain. A rule represents specific knowledge about a problem and is not a complete case. A case is complete, while a rule is synthesized from multiple cases by deduction or induction. Hence, it may not be possible for a complete rule base to be defined. After a satisfactory solution is developed, the new or revised case is stored as a new entry in the case base. This gives CBR a distinct advantage because deduction does not require the complete knowledge necessary to create a set of problem solving rules. Choobineh and Lo (2006) found that in these situations decision-makers preferred the case-based approach.

CBR is then useful to people who are knowledgeable about a task and domain because it gives them a way to access and reuse hard reasoning that they have done in the past. It is even more useful, however, to novices and those who know little about a task or domain (Kolodner, 1991). This feature is important when decision makers are new. It has been observed that traditional rule-based expert systems act as a novice does, following one rule after another until a conclusion is reached. CBR systems more closely approximate an expert's almost immediate insight into a new problem because of characteristics the expert has confronted previously. They see the problem and they know what to do. This "gestalt" deals with the ambiguities of complex problem solving in a way that more closely matches the knowledge retrieval process of a real expert. New decision makers are common in public practice and case-based reasoning will therefore accelerate their growth into experts.

The theoretical and technical aspects of developing a CBR model are well developed. Grupe (1993) identified five prerequisite criteria for the use of CBR to assist a decision-maker.

1. Cases should characterize the problem solving process.
2. Similar problems (cases) are recurring.
3. Weak explanations characterize the selection of solutions.
4. Cases are highly specifiable.
5. CBR information is needed by many people.

A number of general books have been developed to guide professionals through the development of CBR systems. For example, Leake (1996) as well as Bergman and Klaus (1998) have developed textbook style resources that do not presume a computer-based expertise in the theory of artificial intelligence to guide the practitioner.

CBR is proving to be a sound technology as demonstrated though the variety of business and professional applications that are going beyond basic theory development. Li (1999) documents the use of CBR to assist with medical diagnosis and Jang (1993) successfully demonstrated the use of CBR technology to improve analysis of cardiac cases. Recent business applications include GE's adoption of CBR to deal with remote diagnosis of high technology products by call center personnel (Cheetham and Varma 2001) and the development of a CBR model at Deloitte and Touche to identify areas at risk for white collar crime (Watson 1997). The legal profession is also finding applications. Rissland and Daniels (1995) reported success in retrieving case information and Elhadi (2000) reports success in using CBR to develop solutions for new insolvency cases. United Mortgage has adopted CBR to direct lending practices (Kersnar, 2006). The range of these applications explains why a number of standardized software packages for CBR applications have recently become available. Lee and Kwon (2006) have taken the first steps needed to develop a theoretical framework to accelerate the application of CBR to business decisions. Based on our review of the CBR and client evaluation literature we feel that CBR could facilitate more effective client evaluation by audit partners.

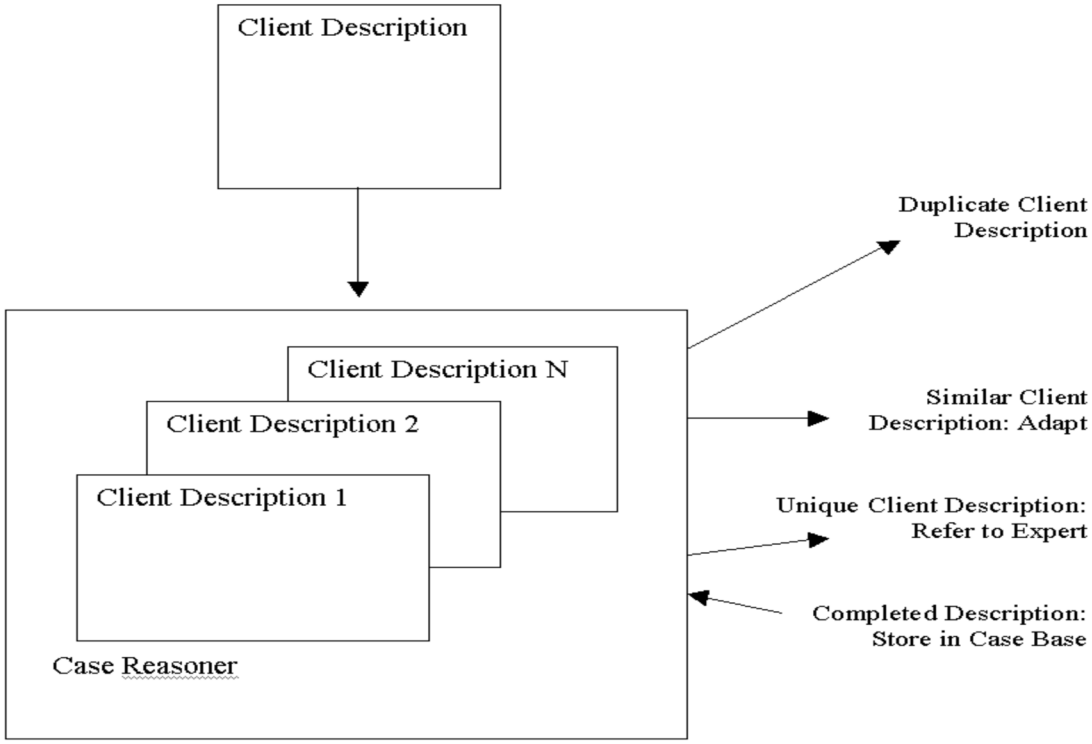
APPLICATION OF CBR TO CLIENT EVALUATION

Leveraging CBR into the public accounting environment offers significant potential to improve the effectiveness of the AEA (Audit Engagement Acceptance) and AP (Audit Pricing) process noted earlier. CBR technology will improve decision-making in an environment in which AEA and AP analysis is being done because of (1) better leveraging of past analysis, (2) avoidance of redundancy, and (3) better justification for decisions and conclusions reached.

Figure 1 (page 22) describes how a case-based reasoning system might be applied in this environment. When a problem case (i.e., a request for a proposal from a new firm) is encountered, the case base is searched for the closest match. That is, we search the case-base (i.e., responses to previous solicitations) for a previously encountered case that is similar to the current case. If there is an exact match (i.e., an audit client description), the previous audit client description can be reused. If there is a close match, the audit client description can be reused by adaptation. A unique audit client description for which nothing about the case matches previous cases requires original case development with expert assistance to determine if there might be another resource upon which to draw. An example would be an instance in which a new case deals with a client that is operating in a unique industry that is not within the auditing firm's realm of expertise. The audit partner would call on the skills of an expert and may also choose to expand the number of attributes (i.e., add additional risk factors) for that case. Whenever a new or modified audit client description is completed, information about that audit client is stored in the case base. Unlike a database search, case searches are approximate and through the acquisition of additional information from the user, iterative.

The earliest CBR applications were developed in non-business areas; now they exist in auditing, banking and other business areas. We were unable to find any CBR applications in the AEA and AP area. The CBR prototype application described here suggests the types of applications CBR can have in business

Figure 1



generally, and in AEA and AP in particular. Doubtlessly, there are other areas in public accounting service management in which CBR is appropriate. One of the key steps in managing an audit practice is to evaluate the reasonableness of and risks associated with accepting an audit client. This involves analyzing a client to generate client characteristics and measuring a potential client along the dimensions of these requirements. It can be used to aid in client acceptance and performing a cost analysis on the audit. Each client's characteristics can easily be transformed into a case. Cases can be added or deleted to the case base easily.

Building An Application

We built an application that targets audit practice management with Orenge 3.2, a CBR construction tool produced by Empolis Knowledge Management (2002). This versatile tool includes a variety of components for (a) constructing and maintaining a case base, (b) searching for and retrieving cases from the case base, and (c) a facility for augmenting case recommendations with expert-style rules. The creation of a case base begins with the establishment of the attributes of cases. For purposes of this study we developed the case attributes to align with established factors used by auditors to assess auditor, client, and engagement risk. Table 1 displays the attributes of the cases used in this application. Attributes are similar in concept to fields and attributes used in database applications. However, the operations used for retrieving cases are more robust than those that are used for database retrievals. The audit risks are listed in the attribute column of Table 1. The attributes displayed in Table 1 are based on the six risk factor structure adapted from "Practice Alert No. 94-3 Acceptance and Continuance of Audit Clients" (AICPA,1999). Figure 2 provides an example of a case in which the attributes (risk factors) listed in Table 1 can be viewed in their relation to the six risk factor structure. The risk factor structure is familiar to audit partners and others in management. Their knowledge of the field is crucial in being able to properly identify and formulate appropriate risk factors (attributes) for case development and retrieval.

TABLE 1
AN EXAMPLE OF CASE ATTRIBUTES

Attribute	Type
Audit Fees	Integer
Audit Firm Turnover	Text
Audit Hours	Integer
Changing Technology	Text
Client	Text
Competition	Text
Complexity Locations	Text
Complexity Subsidiaries	Text
Complexity Transactions	Text
Decentralization	Text
Degree Of Reliance	Text
Emphasis High Earnings Unrealistic Obj	Text
Financial Position	Text
Going Concern	Text
Industry Category	Text
Internal Control Outcomes	Text
Length In Business	Text
Length Of Service CFO	Text
Litigation History	Text
Management Turnover	Text
Mngmt Op Integrity	Text
Regulation	Text
Size Assets	Text
Size Employees	Text
Size Sales	Text

Cases And Their Attributes

The prototype has the ability to use rules similar to those in expert systems to aid in the completion of enquiries and to adapt retrieved cases to meet the search's objectives. A completion rule is used to identify special values in the search criteria and if these criteria are identified, a different weight is assigned to the attributes of that value. For example, the attribute for a firm's gross income is a numerical range. Over a wide range of income levels, the precise value may not be significant. If, however the income levels were extremely low, this would require special attention because it is evident that the potential client is in financial trouble. If, for example, the rule identified the condition that gross income is less than gross expenditures, it would give this attribute greater weight than it would if the comparison showed a gross income that was in excess of expenditures. This would enable the retrieval to find more useful cases.

Adaptation rules recognize that a value in a retrieved case is likely to be misleading because it does not truly correspond to the search criteria. These rules adapt the results after cases have been retrieved. For instance, suppose that the best case addressing the search criteria came from a proposal to a firm in Los Angeles or some other major city where expenses are higher than normal. The CPA firm and the prospective client requesting the audit may be in a low cost of living area, where costs are typically 20% lower. An adaptation rule can be created which automatically adjusts the pricing of a bid to correspond to the lower costs in the area.

String attributes allow the incorporation of free text of unlimited length within attributes. This is especially important for CBR systems, which draw on cases that are diverse in nature. Each new auditing client poses a unique auditing scenario and there are a number of different ways (terms) to describe the characteristics/ risks (attributes) of a potential client. For example, the attribute "What is the financial condition of the client?" could be described in a number of different ways with varying degrees of detail. The advancements in CBR software allow us to store and search cases in both textual (text files) and database (field) formats. We chose to use the database format for illustrative purposes.

Table 2 depicts an Access database with 20 cases (entries) with sample (not a comprehensive list) attributes (fields) structured around the risk factor model. Figure 2 is an example of a written case from which the relevant attributes were extracted (manually) and entered into the access database as a "case entry." (This process can be eliminated by searching text files directly.)

Queries

When one seeks to query the CBR application for cases similar to the needs of the user, the system provides prompts to which the user can respond. Questions associated with the case under review ask whether another audit client case exists that corresponds to the potential audit client scenario. Users answer as many of these questions as they can or wish to. The application comes up with its best matches. Sample questions that can be included are shown in Table 3. Choosing to select or not to select certain attributes, allows for more meaningful retrieval and subsequent decision-making. The next section discusses more ways to accomplish meaningful retrieval.

The Search Process

The search process is initiated with the entry (by selecting the relevant attributes/ risk factors) of the partial description of a new client. This application uses the description to identify and rank potentially matching cases in the case base. It is possible

TABLE 2
A CASE BASE AND SAMPLE ATTRIBUTES

Client Name	Industry	Mngmt Turnover	Sales (in Millions)	Assets (In Millions)	Number Employees
Accessories Online	E-Commerce	Rapid	$5-50	$25-100	100-500
BB Construction	Construction	Slow	$5-50	$5-25	100-500
Consume Online	E-Commerce	Rapid	$1-5	$1-5	> 50
CPC Asphalt	Asphalt Producer	Slow	$5-50	< $100	100-500
Crescent Inn	Hospitality	Rapid	> $1	> $1 m	> 50
Cure Food and Drug	Food and Drug	Slow	< $100	< $100	< 500
David Bean & Co.	Law Practice	Slow	> $1	> $1 m	> 50
Ely Mining	Mining	Rapid	< $100	25-100	<500
Fli West	Airline	Rapid	$50-100	25-100	100-500
Gamble On	Gaming	Average	< $100	$25-100	< 500
Hyperama	Wholesale Distr.	Average	5-50	$5-25	100-500
Insure Me	Insurance	Rapid	$1-5	> $1	> 50
Joe Bloggs, CPA's	Public Accounting	Slow	$1-5	$1-5	50-100
Mexican Eatery	Restaurant	low	$1-5	$1-5	50-100
Not 4 Profit	Not for profit	Slow	$1-5	$1-5	> 50
Quality Metal	Metal Distr.	Slow	< $100	< $100	< 500
Software Developer	Software Design	Slow	> $1	> $1	> 50
Unionized Transport	Freight transport	Slow	< $100	< $100	< 500
Wayside Inns, Inc.	Hotel service	Slow	$1-5	$1-5	> 50
Williamson and Oliver	Public Accounting	Slow	< $100	$25-100	100-500

FIGURE 2
AN EXAMPLE OF A WRITTEN CASE

Project Title: Wayside Inns, Inc.

Wayside Inns, Inc., located in Kansas City, Missouri, is characterized by management turnover[1]. The length of service of key financial staff (the Hotel Manager) is on average . Management's operating integrity and track record is positive[3]. The entity has no going concern problem[4]. The entity [5]. The entity is not vulnerable to changing technology[6].

Wayside Inns, Inc. operates in the Hotel Service industry[7]. The entity has been in business for [8]. The entity has differentiated itself well amidst [9]. The degree of regulation in the Hotel Service industry is [10]. Wayside Inns, Inc. has [11]. The entity has hired the same audit firm since it began operations therefore [12]. TheWayside Inn in Kansas City is a part of the Wayside Inns, Inc. hotel chain. The manager of the Wayside Inn in Kansas has a great deal of autonomy in running the business. Therefore the [13].

With Wayside Inn grossed and booked for the year ended December 31, 2000 (for the most recent fiscal year end)[14]. Wayside Inn of Kansas executes an average of on a yearly basis, operates in one location and has [15]. Management compensation includes a bonus that is contingent on earnings, the size of the hotel investment and a performance factor. As a result there is a [16]. Management has a [17]. In addition, internal control outcomes are [18].

1. Entities Business Risk (EBR) (Management) – Management Turnover
2. EBR (Management) – Length of service of CFO and other key financial staff
3. EBR (Management) – Management's operating integrity/ track record (attitude toward regualtion and ethics)
4. EBR (Entity) – Does the entity having a going concern problem ?
5. EBR (Entity) – Does the entity have an adequate capital base or is highly leveraged ?
6. EBR (Entity) – Is the entity culnerable to rapidly changing technology ?
7. EBR (Industry) – Industry Category
8. EBR (Industry) – Length of time in business
9. EBR (Indusrty) – Degree of competition
10. EBR (Industry) – Degree of regulation
11. Auditors Business Risk – Litigation history
12. Auditors Business Risk – Audit firm turnover
13. Auditors Business Risk – Degree of Decentralization
14. Auditors Business Risk – Size :employees, sales and assets
15. Auditors Business Risk – Complexity : number of transactions, locations and subsidaries
16. Auditors Audit Risk – Emphasis on high earnings bonuses and unrealisitc objectives
17. Auditors Audit Risk – Degree of reliance on estimates, key personal and year-end transactions
18. Auditors Audit Risk – Internal control outcomes (prior year errors, adjustments and the reporting system

TABLE 3
Sample questions guiding queries

Entropy questions corresponding to attributes

1. Is the business vulnerable technology?
2. What is the degree of reliance upon estimates, key personnel and year-end transactions?
3. What is the number of company transactions?
4. What is the length of service of the CFO and other key financial staff?
5. To what degree is their emphasis on high earnings and unrealistic objectives?
6. How many employees are employed by the business?
7. What is the number of subsidiaries?
8. How many separate operating locations are there?
9. Is the business a going concern?

that exactly the right client description can be located, however, that is rarely the case. For instance, a search for a client that is a casino, may find a case from a hotel, which proves to be the best match. In most cases, the system finds the description which should be of most value to the user. The programmer has the power to program the search process to use the attributes in different ways.

Not all attributes need be equally weighted. For instance, attribute "Industry Category" may be more important that the attribute "Management Turnover." When performing queries, users have the ability to adjust the weight assigned to each attribute. The higher the weight assigned to an attribute, the higher the level of importance given to it in the retrieval process. Further, the programmer is able to define similarities between attribute concepts. A simple example is the attribute "Management Turnover" which we decided to divide into three categories or "concepts" in CBR terminology: rapid, average and slow, to align with the terminology used in the AICPA risk assessment literature. One could assign a similarity of 60% between rapid and average. Therefore, in the event that "rapid" is selected for the attribute "Management Turnover" in a new case and a "rapid" turnover case does not exist, those cases with average turnover will still be selected (and ranked accordingly) because there is a pre-defined similarity between "rapid" and "average" such that "rapid" is closer to "average" than it is to "slow." This capability enables the creation of more productive combinations by the search process.

The programmer has the option of creating questions that help guide the user in the retrieval process. The user has the option of scrolling down the list of questions and responding to questions in any order, however, and may even be forced, due to a lack of knowledge, to answer only some of the questions. As answers are

entered in response to the questions derived from the cases, all of the cases are re-ranked. If an answer corresponds to the answer given for a case in the case base its matching score increases. A mismatch degrades the matching score. The questions and the possible answers to them are stored in a common area and are shared by all cases. For example, choosing a different industry category might increase the score for twenty cases and decrease the score for sixty other cases. The matching scores have changed and the order of potential matching cases has also changed.

The user can browse the retrieved cases. Table 4 displays an example of a set of results produced by a query. Note that the example provided does not provide a comprehensive list of attributes (corresponding to each case) or cases retrieved. A comprehensive list of attributes and cases would ordinarily be displayed for browsing and analysis.

The retrieved set of results gives the user a description of the original case, the attributes associated with it, and the closest matching cases. The application can be made to adapt the recommended case automatically or prompt the user to adjust for the adaptation rules. By browsing cases as ranked, the Audit Partner becomes aware of other client descriptions similar to the one under development. Armed with this information, the Audit Partner substantially reduces the "search space." The Audit Partner can review a smaller number of cases to find analyses bearing on the threat of potential litigation, the complexity of the audit, the size of the audit and the potential cost of the audit or in any combination thereof.

Adapting the Client Description

Beyond simply retrieving existing cases and their attendant information, the case base also is able to modify the results retrieved in order to adapt the case to the user's needs. For instance, if a user in one part of the country found a potential client description that originated in another part of the country, rules can be implemented that automatically recommend an appropriate audit price for the user's region. This application incorporates two different kinds of rules (services): completion rules and adaptation rules. Completion rules are used to complete a query or a case from the case base. The rules are of an "if-then" construction. They only execute if the condition is true. Under this circumstance the action part is performed — the rule "fires." They are executed while entering the values of attributes of a case, and, upon retrieval, after all possible adaptation rules have fired. Some actions (i.e., weights, filter and similarity) are

TABLE 4
IDENTIFICATION OF CLOSEST MATCHING CASE

Attributes selected	Attribute value
Audit Firm Turnover	Medium turnover
Changing Technology	Yes
Competition	High
Complexity Locations	1 - 5
Complexity Subsidiaries	1 - 5 subsidiaries
Complexity Transactions	> 25,000
Decentralization	Low decentralization
Degree Of Reliance	High emphasis
Emphasis High Earnings Unrealistic Obj	High emphasis on earnings
Financial Position	Adequate capital base/not highly leveraged
Going Concern	No going concern problem
Industry Category	E-Commerce
Internal Control Outcomes	Favorable
Length In Business	> 5 yrs
Length Of Service CFO	> 5 yrs
Litigation History	None
Management Turnover	Rapid
Mngmt Op Integrity	Positive
Regulation	Low regulation
Size Assets	25 - 100 million
Size Employees	100 - 500
Size Sales	5 - 50 million

PARTIAL RESULTS:

Case Rank	Similarity	Company	Industry	Audit Fees	Audit Time
1	.96	Accessories Online	E-Commerce	$45,000	1500 hours
2	.60	Fli West	Airline	$75,000	3000 hours
3	.54	Williamson & Oliver	Public Accounting	$50,000	1700 hours
4	.50	BB Construction	Construction	$115,000	5000 hours
5	.49	Software Developers	Software Design	$23,000	1250 hours

executed only from the current query and not for all the cases in the case base.

Adaptation rules can be used to derive a new result case from a query and retrieved cases. The main difference between an adaptation rule and a completion rule is the access to attribute values and the number of actions. Completion rules are executed after two events: The obvious event is at the retrieval of a case from the case base. After each input from the user, the rule system checks its rules. The second event is after executing the adaptation rules. In this case only the rules are executed during a consultation session after the retrieval of cases. Copying the retrieved case creates a result case.

FINDINGS AND CONCLUSIONS

This paper set out to demonstrate the applicability of CBR to the expensive and crucial process of assessing new clients. The demonstration project shows that a greater level of firm specific experience can be considered when evaluating potential clients with lower costs to the audit firm. Utilizing a CBR model will assist a firm by:

1. reducing the risks associated with client evaluation and acceptance (engagement risk).
2. reducing the cost and time of client audit evaluation and acceptance.
3. providing a more accurate estimate of the fees to be charged to and the time spent on the audit.
4. helping forge the best "match" with audit clients.

An effective infrastructure is one of the most critical components for long-term success with CBR systems. Users of these systems must understand that the purpose of CBR is to be an aid in the problem solving process. CBR will not necessarily to solve problems completely nor will it remove the need for expert professional assessment. Even the most effectively designed CBR systems lose their value with time. New cases must be specified or indexed correctly. Misclassified cases inhibit the problem solving or analysis process. This is comparable to a very experienced individual who has poor recall and communications skills. Their experience is rendered relatively useless. Similarly, misleading and inappropriate cases should not be retrieved because they will provide confusing information.

Careful planning and implementation of a CBR system will be necessary. A firm must have sufficient knowledge of the purpose of CBR and how it will benefit them. Firms will need to know what changes need to be made to incorporate CBR into their information system. Without this there may not be enough commitment to learn the new processes. The technology of CBR alone is not enough to increase productivity and improve quality public accounting practice management. If implemented with inadequate planning, CBR could easily become a disaster. Proper planning and the adoption of formal administrative methods help set the expectations of the user community and increase the chances of success.

Once the decision has been made to build a CBR system appropriate expertise has to be employed. Gottschauk and Khandelwal (2002) documented the experience of many legal firms in Norway and Australia with knowledge management. Clearly a methodology for building, administering, and maintaining the system must be deployed in order to insure success. Acquiring the expertise to develop an effective infrastructure to support a CBR system might be a difficult challenge for an accounting firm. As noted by Chen and Liou (2002) all such systems require systems expertise but also a willingness of decision makers to embrace the possible productivity gains. All vendors offering CBR construction tools offer consulting services and these services will be critical for success. The application of CBR to the evaluation of new audit clients may provide information professionals a rich opportunity for professional advancement and research.

Public accounting firms are operating in a competitive environment where complex regulations and business risks abound. CBR can be used to help audit firms make informed decisions in engaging audit clients and costing audits. In doing so, risks are decreased and the audit firm's financial condition is not put in jeopardy. Audit firms are able to select clients and correspondingly price audits that will ultimately result in increased productivity and profitability. The solutions are only as good as the case base. It may be easy to lose track of the logic being used in retrieving the case over a prolonged time frame. If the logic is wrong, the application may go awry as the CBR tool learns from the new case(s). Our next step will be to move beyond experimentation with a "live" demonstration project. CBR offers an excellent opportunity for streamlining the AEA and AP process. The potential of this application has yet to be fully explored and developed. This paper is meant to point the way to the next step in realizing those benefits.

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