Using Belief Functions in Software Agents to Test the Strength of Application Controls: A Conceptual Framework

Robert A. Nehmer, Oakland University, Rochester, MI, USA
Rajendra P. Srivastava, University of Kansas, Lawrence, KS, USA

ABSTRACT
Belief functions have been used to model audit decision making for over 20 years. More recently they have been used in assessing the strength of internal controls and information systems security. There has been some research on software agents in auditing, particularly in the web search bot area Nelson et al. (2000). This research used their results to develop an agent model to provide CPA services which add value to client automated systems. It extends the work of Srivastava and others (Bovee et al., 2007; Srivastava & Shafer, 1992; Srivastava, 1997) in belief functions and Nehmer (2003, 2009) in the use of software agents in internal control evaluations. It looks at the problem of monitoring and assuring the adequacy of application internal controls in highly automated transaction processing environments.

KEYWORDS
Agent Frameworks, Application Controls, Belief Functions, Monitoring, Software Agents

INTRODUCTION
Belief functions have been used to model audit decision making for over 20 years. More recently they have been used in assessing the strength of internal controls and information systems security. There has been some research on software agents in auditing, particularly in the web search bot area in Nelson et al. (2000). They suggest that the internet provides auditors with the opportunity to provide their clients with potential new services. They break these services into two broad categories: quality and service. Each category is further broken down into sub-categories. This paper demonstrates that software agents can be used to create both quality and service benefits for clients. This research also extends the work of Srivastava and others (Bovee et al., 2007; Srivastava & Shafer, 1992; Srivastava, 1997) in belief functions by showing an example of the use of belief functions in automated environments to evaluate the effectiveness of systems of internal control. Belief functions allow evidence to be evaluated in situations where the state of nature may not be completely known. That is, using a binary example of belief masses, the belief that a state is true is .6, that it is false is .3 and that we are partially ignorant is .1. The belief masses for the entire frame will sum to 1. This paper also looks at the problem of assuring the adequacy of application internal controls in highly automated transaction processing environments where we do not have complete evidence. The research focuses on risk management, systems of internal controls, and transaction processing environments. In this...
setting, investments in systems of internal controls are justified by their risk reducing properties. By extending the framework reported in Nehmer (2003, 2009) into an application setting, the domain structure is defined in a way to allow the implementation of systems of internal controls as systems of agents which perform control monitoring activities.

There has been a lot of theoretical work done on building stable agent communities. Holland (1995) is a very accessible first pass at some of this work. Fingar (1998) and Farhoodi & Fingar (1997) discuss agent systems from an executive, decision making perspective. However, there have been few formal attempts to define systems of internal controls in the accounting literature. The system defined in this project is based on the risk reducing monitoring activities of a community of software agents.

The research constructs a conceptual model which uses belief functions to determine whether there is sufficient evidence to support the decision to rely on a set of automated application controls. The model defines sufficiency in terms of the output properties of an agent’s belief function. Although interest in using software agents for control of ecommerce applications and continuous auditing has surfaced in recent years, there has not been much formal work on how to apply agent technologies in financial control environments. This research moves this important area forward by providing a software model of the internal control agent community within an automated transaction processing environment.

The paper uses design science methodology (Hevner et al., 2004; Peffers et al., 2007; Geerts, 2011) as its overall framework. Design science is a methodology in the system sciences which formalizes the development of information artifacts as viable research objects. It has been introduced to the Accounting Information Systems domain by Geerts (2011) who shows how the developments in the REA research area over the past 30 years fits into the Design Science Research Methodology (DSRM). Geerts’ work provides the grounding for the use of the DSRM in other areas of Accounting Information Systems Research. We use the DSRM as the methodological framework in which to present the results of our research. That is, we show how our research conforms to each component of the DSRM as introduced by Geerts in the Accounting Information Systems domain of knowledge. There are six principal activities in the DSRM which are discussed in more detail in the following section.

The rest of the paper is divided into five sections. The next section provides an overview of the prior literature. In Section 3, we develop the business situation in which we model the agent community and then model that community using belief functions. This is activity 3 in the design science research methodology as described in the next section (Geerts, 2011). Section 4 provides the computational details of the model, which corresponds to activity 4 of the design science research methodology. In Section 5 we discuss the results and implications. This corresponds to activity 5 of the design science methodology, evaluation of the methodology. Finally, Section 6 provides directions for future research in this area.

Prior Literature

As mentioned earlier, the methodology used in this paper is design science research. Design science is the science of the creation of information artifacts. The paper follows the design science approach introduced by Hevner et al. (2004) and Peffers et al. (2007). More recently Geerts (2011) has brought the design science method to the accounting domain which shows how design science is applicable to accounting information systems research. Following the discussion in Geerts (2011), the methodology has six major activities which need not all be included in a single piece of research. Design science scales to fit research projects which can span many individuals, articles and decades of development. The six principal activities are:

1. Problem identification and motivation
2. Define the objectives of a solution
3. Design and development of an artifact which meets (some of) the solution objectives
4. Demonstration of the solution
Digital Watermarking: Technical Art of Hiding a Message
www.igi-global.com/chapter/digital-watermarking/159446?camid=4v1a

Semantic Web Services for Healthcare
www.igi-global.com/chapter/semantic-web-services-healthcare/24316?camid=4v1a