Abstract
In this paper, a simplified situation is developed in which some software agents are producers of information and other software agents are consumers of information. The CPAgent in the model acts in one of two modes. In the first mode, it can increase the client agent’s reliability of information production and thereby increase information efficiency. In the second mode, it can promote the relevance of the information to the information consuming agent, thereby increasing information effectiveness. The model operationalizes continuous auditing through learning.
The American Institute of Certified Public Accountants (AICPA) is involved in the development of a major new classes of services called assurance services. These services can be understood as a generalization of the traditional audit service which attests as to the “fairness” of the financial statements. Assurance services will “assure” the information consumer of the quality of the information signal sent from any business information source. The problem has been modeled by the AICPA as being composed of the following components: business risk, decision relevance, and systems reliability.

Business risk has been defined as "the threat that an event or action will adversely affect an organization's ability to achieve its business objectives and execute its strategies successfully" (The Economist Intelligence Unit 1995). It can be decomposed into the following parts: strategic environment risks, operating environment risks, and information risks. Information technologies have a huge impact on risk by flattening the organizational hierarchy and empowering employees thereby making many traditional management control techniques obsolete.

Decision relevance is addressed in the model by shifting the focus of analysis from institutional concerns affecting comparability issues to a decision maker centered approach. This approach consists of environmental scanning, definition/construction of measures, sourcing/finding data, and sensitivity analysis. This effectively moves the level of analysis from the public domain (financial statements) to the private domain (decision maker level).

Information technology developments have made enormous processing power available at very low cost. Competitive pressures require organizations to exploit these technologies. Organizations can respond quickly to market threats and opportunities only if they have reliable information available in a timely manner. This information is provided by systems which are affected by continuous round-the-clock processing, greater accessibility and greater dependence on enterprise-wide information systems in flatter organizations, sharing of critical business information with strategic partners, and reliance on packaged systems. Management and owners are increasingly concerned with the reliability of the data produced by these systems. This data needs to be timely, accurate, and accessible. “Nature of Assurance Services. Systems quality assurance provides users with assurance that a system has been designed and operated to produce reliable data. System assurance involves testing the integrity of an information system.” (AICPA, Assurance Services webpage) The solution to this situation is to implement a reliability-by-design model.

The reliability-by-design model will be implemented by systems technologies which should be quoted in length to underscore the reason for our interest in this area. The following sections follow from the AICPA Assurance webpages.
This paper presents a conceptual overview of a simulation experiment involving CPAs and continuous assurance services. In this paper, a simplified situation is developed in which some agents are producers of information and other agents are consumers of information. This type of situation actually models capital markets well, where companies are producing annual reports (information production) and investors are evaluating the reports prior to making investment decisions (information consumption). The CPAgent in the model acts in one of two modes. In the first mode, it can increase the reliability of information production and thereby increase information efficiency. In the second mode, it can promote the relevance of the information to the information consumer, thereby increasing information effectiveness. The model operationalizes continuous auditing through learning.

The model is given some additional theoretical interest by appealing to Habermas’ Communicative Action Theory. In this theory, communication between individuals (agents) is seen as being influenced by four validities: performance, sincerity, legitimacy, and truth. Performance validity refers to the technical construction of an utterance, in this case, to the construction of an informational signal by a information producing agent. Sincerity refers to fit of the signal to the information environment into which it is communicated, that is, that the signal is complete and understandable. In the model, these two validities are affected by CPAgent’s working with information producers. A signal is considered legitimate in Habermas’ theory if the receiver of the information believes the sender has the social standing to send the signal. This is akin to investors recognizing valid investments. Truth validity refers to the perceived truth of the information signal by its consumer. Legitimacy and truth are two validities that the CPAgent can influence on the information consumer’s side.

The paper presents results of simulations run using the above model. Factors that were varied include the information loss function from period to period and the costs of the CPAgents services. Service costs were differentiated between information production assurance costs and information consumption assurance costs. Reputation affects for all three types of agents were also varied. The results indicate a stable model under conditions which are both interesting and realistic. The final section of the paper presents an extension which addresses modeling agents as both information producers and consumers and CPAgents as having aptitude in both efficient information production and effective information consumption activities.

Conceptual Model of this Project:

Information Needs of Decision Makers
- Information on decision model used (metadata)
- Information on defining business objectives and information needs
- Information on designing actions
- Information on measuring model performance (the effectiveness side)
- Information on designing and developing new decision making models
- Environmental scanning
- Finding valuable data in the environment
- Measuring new data items
Systems Reliability Assurance
   COSO internal control framework
   Information reliability for managers
   Information reliability for external parties
   Continuous auditing with software agents
   Specification of the information model of the firm to such detail that an information dual
   is created (emulation)

Communicative Action Theory - Habermas
   Actions
      Instrumental - tool using
      Strategic - social manipulation
      Communicative - Consensus
   Validities
      Performance
      Sincerity
      Legitimacy

Conceptual Model: Operationalization

Information Production: Performance
   Information Transmission: Sincerity
   Agent 1

Conceptual Model: Operationalization

Information Needs: Truth
   Information Reception: Legitimacy
   Agent 2

Conceptual Model: Operationalization

Truth
Environment and Simulations

The environment will reward reliability and relevance differently in different simulations.
CPAs will increase reliability or relevance at a cost.
Population of client agents will have different needs for the two services in different simulations.
CPAs will either be reliability experts, with performance and sincerity enhancing capacities, or relevance experts with legitimacy and truth testing capacities.

Model Formulation

\( P_i \) - Information producers and information consumer
2 x 1 matrix
Performance (validity) and sincerity (truth)
Values < 1
\( A_i \) - CPA reliability expert and relevance expert
1 x 2 matrix as above
Values between .5 and 1.5 (>1 is OK)
\( I_{RM} \) - Information raw material from the environment
1 x 2 matrix of exploitable materials: P and S
\( C_i \) - Cost vector of the CPAs for the two services

Information producing agent:
\[ C_1 I_{RM} P_1 A_1 = SI \]
Information consuming agent
\[ C_2 SI P_2 A_2 = GI \]
GI * loss function = \( I_{RM} \)
As efficiency (effectiveness) increases (decreases), A's parameters are changed
A will capture some of the gain (loss)
\( L = A_{ij} \)'s learning rate
\( A_{ij}' = (L-(1/(1+L)^n)) P * i \)
\( i = (A_{i1}+A_{i2})/(P_{i1}+P_{i2}) \)
Producers & Consumers

Have the same preferences

Producers & Consumers

Have opposed preferences
Agents
with high efficiency and costs

Agents
with high efficiency
Future Research:
  Refine the model
  Model validation
  Use in policy making
  Attempt to get support